The Future of the South Saskatchewan River Basin

Stakeholder Perspectives

Lyndon B. Johnson School of Public Affairs
The University of Texas at Austin
Policy Research Project Report

162

Lyndon B. Johnson School of Public Affairs
Policy Research Project Report
Number 162

The Future of the South Saskatchewan River Basin: Stakeholder Perspectives

Project directed by

David Eaton, Ph.D.

A report by the
Cross-Border Environmental Management Policy Research Project
Group on South Saskatchewan River Basin in Alberta
2008

The LBJ School of Public Affairs publishes a wide range of public policy issue titles. For order information and book availability call 512-471-4218 or write to: Office of Communications, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, Box Y, Austin, TX 78713-8925. Information is also available online at www.utexas.edu/lbj/pubs/.

Library of Congress Control No.: 2008920678
ISBN: 978-0-89940-775-3

Printed in the U.S.A.

Cover design by Doug Marshall
LBJ School Communications Office

Policy Research Project Participants

Students

Hilary Aten, B.A., Political Science/India Area Studies, Kalamazoo College

Marco Campos, B.A., History/French, Rice University

Nishesh Mehta, B.S., Engineering, Indian Institute Technology, Roorkee, India

Elizabeth Ojeh, B.S., Civil Engineering, University of Ibadan

Emily Sentelles, B.S., Education, Brown University

Zachary Simpson, B.S., Economics/Mathematics, Oklahoma State University

Brandon Steinmann, B.A., Political Science/History, The George Washington University

Charles Stern, B.A., Political Science/History, Southwestern University

Alicia Frances Williams, B.S., Criminal Science, B.A., Psychology, University of North Carolina – Charlotte

Project Co-Director

Marcel Dulay, P.E., Doctoral Candidate, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin

Project Director

David Eaton, Ph.D., Bess Harris Jones Centennial Professor in Natural Resource Policy Studies, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin

Table of Contents

List of Tables

List of Figures

List of Acronyms

CBEM	Cross-Border Environmental Management Group
CGY	Calgary, Alberta
EDM	Edmonton, Alberta
GIS	Geographic information systems
LBJ	Lyndon B. Johnson
LTH	Lethbridge, Alberta
PRP	Policy Research Project
SG	Stakeholder group
SSRB	South Saskatchewan River Basin
UL	The University of Lethbridge in Alberta
UT	The University of Texas at Austin

Foreword

The Lyndon B. Johnson School of Public Affairs (LBJ School) has established interdisciplinary research on policy problems as the core of its educational program. A major part of this program is the nine-month policy research project. This research project is comprised of two or more faculty members who direct the research of ten to thirty graduate students of diverse backgrounds on a policy issue of concern to a government or nonprofit agency. This "client orientation" brings the students face to face with administrators, legislators, and other officials active in the policy process and demonstrates that research in a policy environment demands special talents. It also illuminates the occasional difficulties of relating research findings to the world of political realities.

LBJ School graduate students interviewed 42 stakeholders in the Province of Alberta about the future of water use within the South Saskatchewan River Basin (SSRB). The report describes performance metrics to evaluate whether conditions in the basin are improving. It also examines current and potential water issues in the SSRB to develop ideas about policy initiatives that could improve basin conditions.

Finally, it should be noted that neither the LBJ School nor The University of Texas at Austin necessarily endorses the views or findings of this report.

James Steinberg
Dean

Acknowledgments and Disclaimer

This report was drafted as a group effort by students in a Policy Research Project (PRP) on Cross Border Environmental Management of the Lyndon B. Johnson (LBJ) School of Public Affairs of The University of Texas at Austin (UT). Those class members included Hilary Aten, Marco Campos, Nishesh Mehta, Emily Sentelles, Zachary Simpson, Brandon Steinmann, Charles Stern, and Alicia Williams. David Eaton along with co-instructor Marcel Dulay provided guidance and supervision to the class. Lucy Neighbors and Lori O'Neal of UT provided additional logistical support in the project research and report drafting. Marcel Dulay guided members of the class in the techniques of narrative interviewing and qualitative analysis of interviews. Four colleagues (Dennis Fitzpatrick, David Hill, Bob Sandford, and Dan Sheer) provided guidance and advice to project members. Penny Pickles of the University of Lethbridge did a remarkable job organizing stakeholder information and arranging the logistics for stakeholder interviews. The University of Lethbridge contributed staff and equipment to videotape stakeholder interviews and convert video images into digitized files that facilitated the use of qualitative analysis software. Each of the interviewees had an opportunity to review their comments and descriptions for accuracy of meaning and intent.

The PRP received financial assistance from the University of Lethbridge in Lethbridge, Alberta, Canada. Additional sources of support were provided by the Institute for Innovation, Creativity and Capital (IC^2) of UT and the Bess Harris Jones Centennial Professorship of Natural Resource Policy Studies, the Kozmetsky Global Collaboratory at UT-Austin, and the Cross-Border Institute for Research and Development at UT-Austin. This project would not have been possible without the encouragement of the University of Lethbridge, the Alberta Irrigation Projects Association of Lethbridge, and HydroLogics of Columbia, MD, for the use of the narrative approach to dispute prevention. None of the sponsoring units (including the LBJ School, The University of Texas at Austin, the University of Lethbridge or HydroLogics) endorses the views or findings of this report. Any omissions or errors are the sole responsibility of the authors and editors of this report. Alex Wong edited video-taped materials that report stakeholder statements in a video format. Paul Hobart copyedited the manuscript and prepared it for publication. David Eaton edited the report.

Executive Summary

The purpose of this study is to report the opinions of 42 water users and stakeholders regarding the future of water quantity and quality in the South Saskatchewan River Basin (SSRB) in Alberta, Canada (see Figures 1.1 and 1.2 for maps). The SSRB provides a challenge to sustainability as it is an international watershed draining three Canadian prairie provinces and Montana. This project was developed to document the statements of Alberta stakeholders regarding their preferences for future water use in their portion of the SSRB. The project staff consisted of nine graduate students who interviewed 42 water users within the SSRB. Interviewees included members of the First Nations, farmers, small business owners, land developers, persons affiliated with conservation groups, environmentalists, staff from cities, provincial government, and water districts, as well as scientists from the University of Lethbridge, the University of Calgary, and the University of Alberta. The goal of the interview process was to listen to stakeholders' diverse concerns over water use in South Saskatchewan River Basin and to describe stakeholder preferences for future use of the basin's water. Interviews were conducted by teams in Lethbridge, Calgary, Edmonton, and at various First Nations locations.

Despite the diversity of the stakeholders, there were many opinions repeated by nearly everyone interviewed regarding their views for managing the SSRB. Each of the interviewed stakeholders recognizes the finite water resources of the South Saskatchewan River Basin and the challenges to effective management of that resource to sustain the lives and economic activity within the basin. Stakeholders report that sustainability ought to be a goal of SSRB managers along with policies that provide adequate availability and quality of water for current and future users, including the river's role as a productive aquatic habitat. Many interviewees reported that within the SSRB both water quantity and quality problems affect domestic and recreation use. Nearly everyone advocated enhancement of the sustainability of in-stream aquatic life. Almost all interviewees repeated similar consequences that could result from a failure to act: more water scarcity; harm to the natural ecosystem; more disputes over water; and water rationing in the event of drought.

There was a widespread perception that global climate change is an issue that SSRB water managers ought to address. Many interviewees agreed on some possible actions to address these problems: public education about water, cooperation among stakeholders, and better water management. There was a broad consensus too on the barriers to actions, including public resistance to change, insufficient public knowledge, and distrust among SSRB stakeholders. Many interviewees cited some of the same aids to action, including Alberta's "Water for Life" strategy, watershed councils, and efforts to study alternative water management strategies through the use of river basin models or river basin stakeholder consultation. There was a surprising degree of unanimity in what very diverse stakeholders repeated as the ideal outcomes for the basin: healthy ecosystems, water availability for diverse uses, cooperation among stakeholders, and an educated public. Many stakeholders expressed concerns for preventing a possible future water

crisis by using comprehensive water models of the river basin to help planners identify sustainable practices.

Stakeholders did express differences in opinions, particularly with respect to actions to address issues with SSRB management. Some stakeholders expected urban areas to conserve; others expected agriculture or industry to conserve. It was interesting that interviewees were as likely to expect as much of persons with their own interests as of others. For example, rural residents supported conservation in agriculture, persons in urban areas advocated urban water use efficiency, and industry employees expected corporate responsibility. There were differences in views among stakeholders in whether to invest in additional on-river storage. Some interviewees blamed others, such as other interest groups, the existing water allocation legal systems, or government agencies for failure to act appropriately. There remains a diversity of views about the existing water rights system and whether future users should be accommodated by existing users.

Despite the differences in some views, the overall impressions of SSRB stakeholders is that they expect all of the interested parties to work together to develop solutions. Interviewees were optimistic and want to accommodate diverse river water uses and users. If SSRB stakeholders can work together with the same good will as they have indicated in the interviews, there is a reasonable chance that disputes can be prevented, crises avoided, and solutions found to the water management challenges of the SSRB.

Chapter 1. Stakeholders' Preferences for the Future

There are many competing uses for the limited water resources of the South Saskatchewan River Basin (SSRB) in Western Canada, including drinking water for people and animals; water for industry, mining, irrigation, and the fossil fuel industry; and in-stream uses such as recreation and support for ecosystem plant and animal life. Managing the tributaries within the basin is not easy because the river system drains water from the provinces of Alberta, Saskatchewan, Manitoba, and the U.S. state of Montana, as well as First Nations and American Indian lands including diverse mountain and plains ecosystems. Farmers, industries, cities, and recreation interests depend on the river system in Alberta, as do the plants and animals within and along the rivers. (See Figures 1.1 and 1.2 for maps.)

This project began when the University of Lethbridge (UL) invited the LBJ School of Public Affairs of The University of Texas at Austin (UT) to join in a cooperative effort to apply UT's "dispute prevention" narrative interview approach to learning about SSRB stakeholders' preferences for future water use. Dennis Fitzpatrick, Vice President of Research at UL, was asked to recommend a list of persons from the SSRB who might be willing to be interviewed. Dr. Fitzpatrick, David Hill of Alberta Ingenuity, and Bob Sanford of the United Nations' "Water for Life" program developed a long list of possible interviewees. Penny Pickle of Lethbridge University then asked the interviewees whether they were willing to participate. The persons who are included in this report as interviewees are those who were willing to be interviewed and could be reached during the 10 days that graduate students had available for field interviews in Alberta during January 2007. Both UL and UT made every effort to include as diverse a set of interviewees (based on profession, location, and issues of concern) as possible. The approach was designed to be inclusive so as to highlight different views and avoid an artificial unanimity.

UT graduate students participating in the Cross-Border Environmental Management (CBEM) Policy Research Project interviewed 42 persons representing a variety of interests within the SSRB, including members of First Nation communities, farmers and ranchers, state and federal governmental officials, proponents of in-stream wildlife or recreation, environmentalists, municipal representatives, irrigation district officials and board members, university faculty, industry employees, and other water users. To compare the views of interviewees, the UT students developed skills in interviewing and qualitative analysis to interpret social and economic concerns pertaining to water use in SSRB. They used ATLAS.ti® software to evaluate stakeholder perspectives to identify common themes among stakeholders as discussed below.

This chapter reports on the methodology to document stakeholder preferences for future water use in the SSRB. Table 1.1 lists the labels used to code stakeholder interviews. Without a system for organizing interviewee comments into categories, UT students

would not have been able to identify shared views and differences in opinion. This coding system is used in the three appendices of this report.

Table 1.1
Coding Labels for Stakeholder Interviews

Problems

- Water quality
- Water quantity
- Damage to riparian ecosystem

Causes

- Climate change
- Population growth
- Residuals from water use
    - Agricultural
    - Industrial
    - Pharmaceuticals
    - Domestic sewage
- Existing system of water allocation
    - Licensing
    - Prior appropriation
- Infrastructure

Consequences if No Action

- Water shortages
- Damaged ecosystem
- Unusable water
- Health impacts
- Economic stagnation

Potential Actions

- Monitoring
- Groundwater inventory
- Enforcement
- Planning
- Management
- Education
- Public involvement
- Other

Barriers to Action

- Public differences over what can realistically be accomplished
- Differing opinions on the extent of the government's responsibilities
- Differing viewpoints on problems and solutions
- Lack of public information
- Resistance to change
- Political "will"
- Accountability
- Lack of data
- Scientific research

- Other

Aids

- Strategic planning
- Educational initiatives
- Financial incentives
- New technology
- Public support
- Conservation groups
- Other

Ideal Future

- More water availability
- Pollution control
- Healthy ecosystem
- Sustainable development
- Educated public
- Success according to performance measures
- Reduce consumption
- Holistic management
- Other

Metrics

- In stream flow measurements
- Water quality standards
- Biodiversity indicators
- Surveys measuring education
- Per capita demand
- Value of licenses
- Other

Appendix A reports stakeholder views by interest group to test a common presumption that a person's employment or profession is associated with a point of view. Appendix A tests that perspective by listing actual quotations of persons (edited for brevity), allocated to each person's self-identified interest or profession. Appendix B lists interviewee comments by home location within the basin to test another common presumption that where a person lives can influence that person's preferences for future water use in a basin. Appendix B lists actual quotations of persons (edited for brevity) by each person's location in the upper basin, mid basin, or lower basin. There are more similarities than differences among persons of different professions and locations with respect to the eight components of a water narrative (see Table 1.2).

Appendix C lists the remarks of interviewees who agreed to waive confidentiality to allow her or his views to be attributed to the individual source. The appendix reports stakeholder interviews through a summary followed by quotations taken from the interviews. Quotations are ascribed to any individual who wished to be credited with her or his remarks. Other quotations remain anonymous. Each interview subject was asked a common set of questions, although the order and wording may have differed, as different class members asked the questions. Each interview was videotaped in order to be able to

assess its content after the fact. Interviews were converted from digital recordings to standard digital record format compatible with ATLAS.ti® software for quotation analysis. Staff coded and classified each stakeholder's comments into eight categories; these findings may be of interest to the various stakeholders as they move forward to address Alberta's water future.

Table 1.2
Elements of a Water Narrative

1.	What are the water problems?
2.	What are the causes of these problems?
3.	What are the consequences of failing to address these problems?
4.	What actions could ameliorate the problems?
5.	What barriers to action exist?
6.	What aids to action are in place?
7.	What is the stakeholder's ideal future?
8.	What are the metrics to measure success?

How Stakeholders Agreed and Disagreed

There are common themes among the 42 interviews as well as individual differences. Interviewees concurred that rapid population growth is responsible for many of the current water management problems in the SSRB, including the over-allocation of existing water resources, its decreasing availability and degradation of water quality. Stakeholders expressed a common preference to draw on baseline data, seek new information, and use other scientific resources to improve planning in the region, such as basin-wide water modeling that considers both surface and subsurface water. Nearly every stakeholder indicated a personal preference that:

- The SSRB remain a reliable source of water supply;
- Better data is important to help stakeholders evaluate alternative management options to prevent future water basin crises;
- Monitoring be developed to measure water quantity and quality;
- Management plans, such as Alberta's "Water for Life" strategy, involve both water basin advisory groups and governments;
- Dialogue among stakeholders is important; and
- The public should become educated about potential water issues.

Disagreements remain among individual stakeholders, such as priorities among water uses, the precedence of residential and industrial users over irrigation, the extent to which water storage and diversions should be relied upon to solve future water crises in the region, the adequacy of the prior appropriation system of water law, or the effectiveness of city policies that encourage non-consumptive water users. Stakeholders disagreed on which water uses should have priority, as many users' concerns related to their priority future uses. For example, some farmers sought assurances about irrigation, environmental advocates expressed concern about in-stream flow, and city dwellers focused on potable water. Another topic of difference was the extent to which water storage should be relied upon to buffer potential water shortages. There was a diversity of views about the value of the existing prior appropriation system that governs current water allocations. For example, different stakeholders expressed three views about priority water licenses: (a) they are valued as an allocation mechanism; (b) appropriate new uses should not be barred by prior appropriations; and (c) no additional water uses should be permitted.

There were some differences in views that appear to reflect the origin of the speakers, as discussed below. For example, citizens from the First Nations stated that people matter and that modern problems such as climate change, government regulations, or development in the oil and gas industry should not undermine the quality of peoples' lives or livelihoods. Their solutions include more systematic citizen participation among all stakeholders, including First Nation communities, so that the spiritual and practical values of water can be sustained.

A common response by people affiliated with universities was a concern about water use by a growing urban population. Possible individual actions included increasing water prices, a review of "first in right, first in time" rules, involving citizens in the decision process, and implementation of educational programs, such as the "Water for Life" strategy.

Industry sector participants took note of the economic development both within and around the river basin. Solutions to possible water conflicts included enforcement of water licenses, increased reliance on groundwater, enhanced water storage, management of surface flows within the river, and industrial use of brackish water.

Stakeholders who characterized themselves as environmentalists or conservationists viewed increasing urbanization and lack of legal protections for water as causes of potential water crises. They agreed that possible solutions included increases of water pricing, limits on water licenses, dialogue among stakeholders, and community education about ecology and major water issues.

Persons employed in the government reported that citizens' limited knowledge of water limits could affect their water-use behavior and that governments have limited authority to manage use because of the water license system. Their solutions included cooperation, public education, increased infrastructure investment and responsible development.

Stakeholders were also separated into three different regions in which they live within the SSRB and by the locations where interviews were conducted: the mountain/upper region, city/urban region, and the southern/prairie region. The mountain/upper region included stakeholders in the glacial headwaters of the SSRB, such as Banff and Canmore. The city/urban region included stakeholders representing the interests of Calgary and Edmonton residents. The southern/prairie region included the rural stakeholders in the southern portion of the SSRB and stakeholders from Lethbridge.

In the mountain/upper region, stakeholders expressed a concern with the disappearance of the wetlands in the Bow River Basin, which they argued could lead to an overall decrease in water availability, lower aquifer levels, and poor water quality. Suggestions for specific actions that needed to be taken included: implementing market mechanisms or water pricing; aligning conflicting government policies; providing adequate feedback that would help in making decisions based on exemplary management practices; and maintaining sufficient funding for volunteer groups to assist in resolving issues.

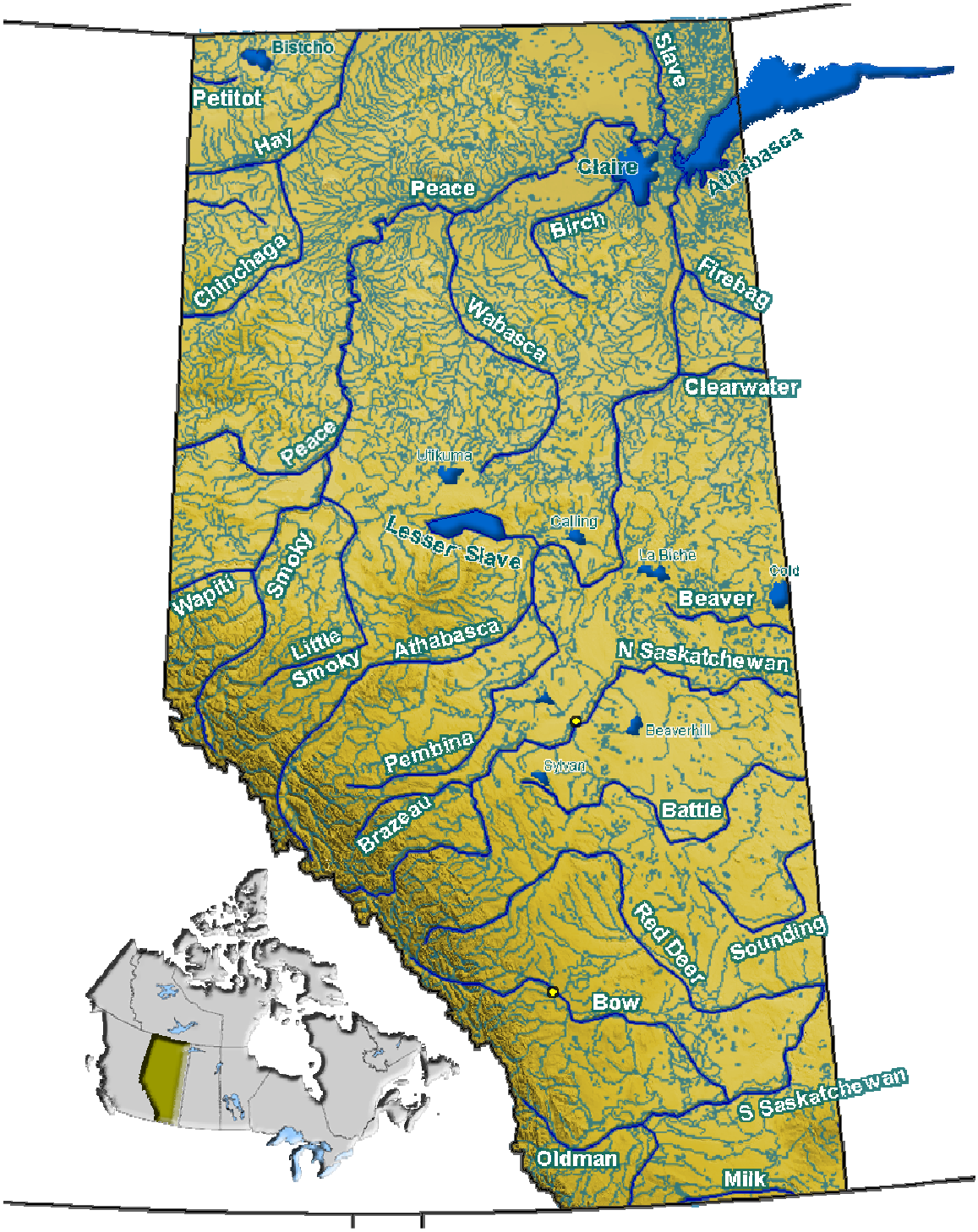
City/urban region residents discussed restrictions on water use that would limit water withdrawals and help maintain water quality. Some interviewees discussed the idea of a comprehensive review of existing water resources to provide information for sustainable management plans to be developed by a full range of basin stakeholders. These plans would include wastewater or storm water management strategies and programs to educate the public about the importance of water sustainability.

Nearly all residents of the southern/prairie region reported that the over-allocation of water within the basin and low in-stream flows created a risk for the ecosystem. Many in the prairie region advocated implementation of public support initiatives that involve water basin advisory groups as well as corporate sponsorships to enhance water awareness.

Despite the differences among stakeholders within the SSRB, the degree of commonality in the stakeholder perceptions of problems and solutions is surprising. Many diverse stakeholders within the South Saskatchewan River Basin expressed concern with both water availability and water quality. Many interviewees advocated water metering, implementation of educational programs, and a community process to foster cooperation among all stakeholders.

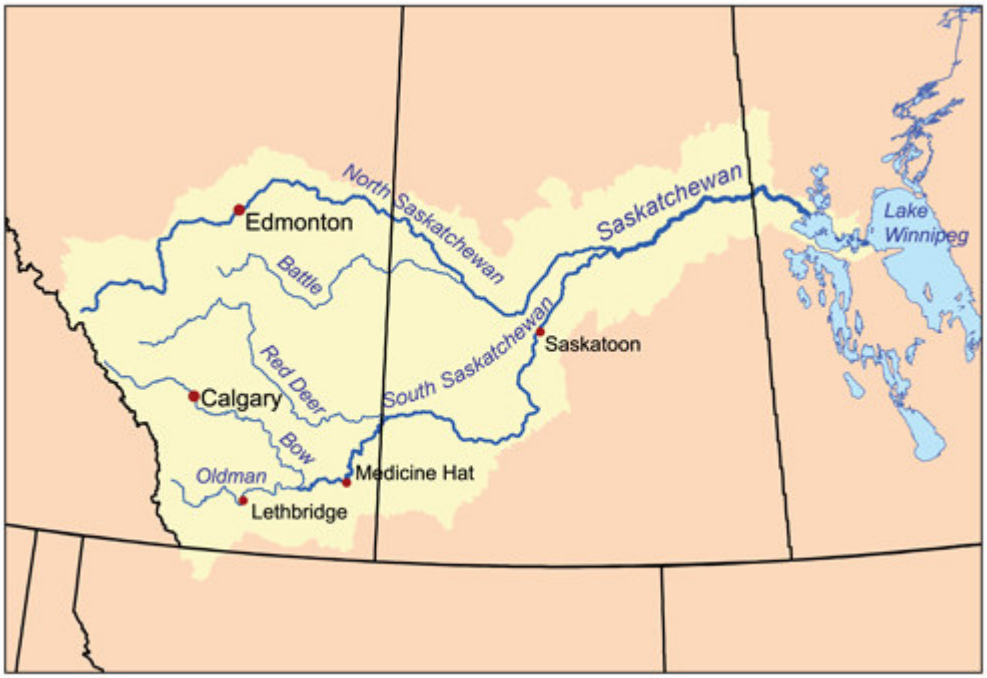
Stakeholders from all regions expressed their desire to work together with other groups to create a water management plan that takes into account various interests in the South Saskatchewan River Basin. Stakeholders report that competing demands among water users and climate uncertainty could continue into the future. The stakeholder consensus is preference for basin-wide common efforts to plan and manage the SSRB.

Figure 1.1
Alberta Rivers



Source: Atlas of Canada. Online. Available: http://atlas.nrcan.gc.ca/site/english/maps/ environment/ hydrology. Accessed: September 17, 2007.

Figure 1.2
Map of South Saskatchewan River Basin



Source: Atlas of Canada. Online. Available: http://atlas.nrcan.gc.ca/site/english/maps/ environment/ hydrology. Accessed: September 17, 2007.

Appendix A.
Stakeholder Views by Interest Group

As indicated in Chapter 1, interviewees were selected because of their diversity in both their profession and primary interests for river basin management. The design of the interview phase sought to highlight differences so that local interviewees would discuss the full range of choice. A common perception in studies of water stakeholder preferences is that a person's identity or source of employment can determine a person's preference for future water use. This study sought to organize interviewee comments both by the topic of concern and by the stakeholder's stated self-identification, so as to observe common ideals as well as individual or group differences.

Surprisingly, when grouping stakeholders by interest group it was not their differences, but their shared perception of the problem, ideal situation, and barriers and aids to action that united stakeholders. Although the "aids to action" category garnered significant differences, most groups still viewed the "Water for Life" strategy and other educational programs as vital to ensuring sufficient water is available in the future.

The following tables and lists of quotations document water-user views by employment or affiliation groupings, including First Nations, industry, agriculture, environmentalists, or employees of universities or governments. Specific comments made by each interviewee are included in Appendix C.

Table A.1
Common Stakeholder Narrative Themes

TOPIC	OPINIONS
Problems	Water supply or available quantity is decreasing Water quality is deteriorating
Causes of Water Problems	Urban expansion and a growing population Climate change Increased industrial and agriculture water use Over-allocation of water resources in the basin
Consequences if No Action	Scarcity of water Increased damage to natural ecosystem Water-rationing More disputes over water More severe droughts
Possible Actions	Increased public education Cooperation among all stakeholders to work together to find solutions Water limits in urban areas
Barriers to Action	Resistance to change Resistance to political change or inaction by government Lack of public knowledge of water Distrust among stakeholders
Aids to Action	Educational programs such as "Water for Life" Use existing technology that can help to assess water models Watershed Councils
Ideal Outcomes	Healthy ecosystems Cooperation among all water stakeholders to manage water Educated public and industry users about water and its limits
Metrics	Monitor in-stream flow levels Set levels for water quality Monitor ground water levels Monitor river ecosystems and wildlife

Source: Interviews with CBEM stakeholders.

Table A.2
First Nations Stakeholder Narratives

TOPIC	OPINIONS
Problems	Rivers are drying up Water quantity reduced Natural wildlife and river ecosystems are being destroyed Water quality is decreasing
Causes of Water Problems	Climate change Rigid government regulations and policies Pesticides in water Oil and gas development
Consequences if No Action	Rivers will likely dry up in 50 years Isolation Lost opportunity to gain knowledge
Possible Actions	Revise government regulations to invite more citizen advice Open dialogue and consultation with all stakeholders, including the First Nations Identify sources of water Study environmental impact to ensure water source sustainability Recharge aquifer Tertiary treatment of wastewater
Barriers to Action	Mistrust with government Lack of interaction with other stakeholders Governmental bureaucracy Legal processes regarding water
Aids to Action	First Nations willing to co-operate with government and surrounding communities Treaties Focus on spiritual value of water
Ideal Outcomes	Water policy based on sharing rather than regulation Water meetings would start with a prayer and sharing of pipe to guarantee integrity and loyalty to one's word Adoption of a philosophy that speaks to the sacredness of water as a resource
Metrics	Water clarity and quality Quality measurement of the natural habitat and river ecosystem

Source: Interviews with 2 CBEM stakeholders.

Table A.3
Industry Stakeholder Narratives

TOPIC	OPINIONS
Problems	Basin water has been over-allocated
Causes of Water Problems	Population growth Increased development around river basin Poor enforcement of water licenses has led to high use
Consequences if No Action	Lack of additional urban development Reduced agricultural production Water rationing for rural areas Less flexibility in water allocation schemes More severe droughts Water quantity could be a future issue
Possible Actions	More groundwater and surface flow monitoring Increased industry use of brackish sources over freshwater Province should set up a basin advisory committee
Barriers to Action	Lack of understanding concerning river basin capacity Lack of enforceable water management strategies Existing "first in time, first in right" rules
Aids to Action	Advisory committees to manage water resources
Ideal Outcomes	A "basin advisory committee" that including all stakeholders working together to manage water usage. Stakeholders manage the water in an efficient manner that does not require a solution imposed on them
Metrics	Fish populations as indicators of river health Test water quality for nutrient loading Producible acres of agriculture land In-stream flow records Measures of land management in the basin Wetland acreage created or destroyed Level of fish population

Source: Interviews with CBEM stakeholders.

Table A.4
Agriculture Stakeholder Narratives

TOPIC	OPINIONS
Problems	Water quality is declining Water quantity is declining
Causes of Water Problems	Population growth Over-allocation of water Increased agriculture water use Climate change Increased industrial water use
Consequences if No Action	More disagreements over water Lack of water Inability for farmers to irrigate crops Lack of good drinking water
Possible Actions	Meter water usage Create incentives for conservation Increase public awareness of water's limits Increase water storage capacity Water limits in cities Establish best water management practices
Barriers to Action	Lack of public education about water Lack of knowledge of water's limits Resistance to change Change is expensive Lack of government involvement Legal limits to changing water rights
Aids to Action	Educational programs such as "Water for Life" Use existing technology to educate about water Watershed planning groups
Ideal Outcomes	Efficient irrigation methods Metered use of water Right to convey water and charge for it Increased water storage capacity Agreement among all stakeholders on water's future High levels of water conservation
Metrics	Test irrigation waters for nutrients Guidelines for water usage Measure in-stream flows Measure water quantity and quality

Source: Interviews with 6 CBEM stakeholders.

Table A.5
Environment Stakeholder Narratives

TOPIC	OPINIONS
Problems	Downstream water quality declining Impending droughts Lack of available water Decreasing in-stream flows
Causes of Water Problems	Increase in urbanization Climate change Over-allocation of water Lack of legal protections for water Increased agricultural and industrial use
Consequences if No Action	Ecosystems along river will degrade Water will be privatized Future water shortages More legal disputes over water Negative health effects to citizens
Possible Actions	Agreement on major water issues Dialogue on water amongst all stakeholders Establish water pricing Implement regional water planning Fund "Water for Life" program Comprehensive review of surface and ground water Issue no new water licenses Public involvement and education Use Fisheries Act to force water responsibility
Barriers to Action	Current "first in time, first in right" rules Political pressure for no change in water policy Distrust among stakeholders Lack of public awareness of water New technology is expensive
Aids to Action	Increased water advocacy More educated society Educational programs such as "Water for Life" Watershed Councils
Ideal Outcomes	Water users become aware of limits of water Good watershed management plans A provincial water strategy Better water storage Healthy ecosystems Reduced pollution in river Increased in-stream flow
Metrics	Water users' satisfaction survey No net loss of water for the province Five year review of water levels for water quality and quantity Monitor health of aquatic ecosystems Check total phosphorous, bacteria, and pesticide levels Limits of point source discharge Level of water quality Use biodiversity indicators

Source: Interviews with 11 CBEM stakeholders.

Table A.6
University Stakeholder Narratives

TOPIC	OPINIONS
Problems	Water in short supply Habitat and ecosystems harmed by water withdrawals and quality Water quality deteriorating
Causes of Water Problems	Over-allocation of basin water resources Limited water resources Climate change Urban expansion and a growing population Increased industrial and agriculture water use
Consequences if No Action	More scarcity of available water Increase damage to natural ecosystems Water rationing Water quality will steadily decline
Possible Actions	Revisit water rights (first in time, first in right) Increased public education Enact watershed usage plans No new water allocations Fund collaborative research and technology Place a price on water Meter water for all users
Barriers to Action	Resistance to change Lack of public knowledge of water
Aids to Action	Citizen's participation in water use process Increased data on water flows and usage Educational programs like "Water for Life" New technology
Ideal Outcomes	Healthy, functioning Saskatchewan River Cooperation among all water stakeholders Educated public and industry users
Metrics	Monitor water flow and in-stream flow levels Set levels of water quality Monitor groundwater levels

Source: Interviews with 5 CBEM stakeholders from universities.

Table A.7
Government Stakeholder Narratives

TOPIC	OPINIONS
Problems	Decrease in water availability Decrease in water quality and water flow Lack of knowledge of ground water supply Over-allocation of water
Causes of Water Problems	Population growth Climate change Increased water demand by industrial and agricultural users Diversion of water Climate change and drought Antiquated water licensing system Limited authority of government to manage water usage Poor irrigation infrastructure Ignorance of the limit of water availability
Consequences if No Action	Drop in available water and its reliability More legal battles over water Limits on new social and economic development No new water licenses Continued degradation of water quality Collapse of nearby cities
Possible Actions	Cooperation Responsible development Market incentives Public education Alternative sources and conservation Infrastructure investment
Barriers to Action	Resistance to change, public apathy Insufficient financial resources Lack of knowledge about water's limits Political inability to force change
Aids to Action	Educational programs such as "Water for Life" Local government involvement Models of surface and groundwater resources and use Effective technology Watershed Councils Incentives and education for agricultural users Improved public education
Ideal Outcomes	Cooperation among stakeholders A comprehensive management strategy A functioning regional water management structure Increased water storage No net loss water policy within cities
Metrics	Ground water inventory Individual water meters in cities Monitor water quality, quantity, and in-stream flows Set water consumption targets Monitoring wells Price on water

Source: Interviews with 15 CBEM stakeholders.

Table A.8
First Nation Stakeholders' Views

Problems
In one of our smaller creeks you certainly notice the difference in that water has almost become non-existent. Once mid-summer comes along it dries up… it never used to do that because we'd always had lots of fish in there. But now we get all these smaller little rainbows, and brooks and cutthroats that just don't grow because they just don't have the water going through the creeks. That's what I notice the most. One thing that is different is how the animals are adapting to it. I don't see as many frogs as we used to have, especially the northern leopard frog ... Our access to water has been usually through… traditional pumps. A lot our people are forced (to) haul drinking water and household water. Most of our water is very hard and has a lot of minerals in it. So we do not have the best quality water here for household purposes. We cannot exist without water. Clean, pure water is becoming a thing of the past. Most of us drink bottled water now. We have to because we do not have enough clean water to drink. We certainly don't drink water out of the river. It's contaminated… Most of that contamination is placed upstream. The water source that most of our tribal households use is trucked to their homes and dumped into water systems. It makes you more aware and conscious of the quality of your water and what you are going to use it for. So we've had to conserve water almost overnight. Historically we could go to the river and bath in it, wash in it and drink from it, but not anymore. The quality of water in a lot of homes that we've built, the quality of their wells… appears to be getting worse. We are noticing a lot of manganese coming up and it's kind of common to this area anyway. Some of these wells are starting to go septic with sulfur. I don't know what we can attribute that to… there is no conclusive research done to say. When we bring these issues to the attention of Health Canada and they test it, they still maintain that under Health Canada's guidelines the water is still safe to drink. But that was never the case before because everybody really did have good water. There is certain hardness to a lot of the water. Now we are just kind of noticing that we have to test more often. A lot of homes get tested quite a bit. We have water testers that go out every week. Some of the ones get tested every week but every well gets tested at least twice a year. Even though we have water surrounding us we are not able to utilize it other than for agricultural purposes. At one point, we… First Nations people took it for granted that we could go swimming, fishing or trapping, and that is no longer possible. We've had a few homes...one home in particular I think we've drilled five wells there in different spots trying to locate water. I just finished drilling two wells here just before Christmas time and both of them have come up dry.
Causes of Problems
I remember in 1970-1975, approximately 70,000 acres of prime virgin land was broken up for the purpose of agriculture. That has changed our landscape. At that time there were not the management practices that farmers have to adhere to today, so we suffered a lot of soil erosion. Of course the winds that we have in southern Alberta, we lost a lot of prime land and of course we disturbed and affected a lot of natural habitat as well. One thing that is happening on the reserve here is there is a lot of gas and oil development drilling. There is always a claim that it doesn't affect the drinking water, but we can't find any evidence to say otherwise.

The province, in their wisdom, they over-licensed that river so access to water on that river off the reserve. They pretty well have a moratorium… where no one can get any license.

Consequences if No Action

We have issue with the Alberta government... they've put a moratorium on the entire South Saskatchewan River Basin. The Elbow River is part of that and what they are saying is no more water for anybody. At one time they tried to do a consultation with all the Treaty Seven area but they went about it all ass backwards and they've kind of shot themselves in the foot really because what's come out of that is possibly court action from a lot of the Nations in this area about… not proper consultation about what a strategy is going to look like.

I see very severe consequences. I am aware that the Bow River, its origin is from a glacier. And there's been predictions that that glacier—again it's linked to global warming concerns—the source of that water could dry up within maybe 50 years. I've heard that number. We often think that's someone else's problem, it's not in my back yard. But it is really. What happens there, let's say with the Bow River, and could easily happen with the St. Mary's River or the Belly River which have their sources somewhere in the mountains. So we all have the same concerns and the same issues that we need to deal with.

Consequences of inaction could lead to drying up of major water sources.

I've looked at some of the research that's been done, some of the scientific research and they say that everything is cyclical and that the last hundred years were the wettest years on record and now everything is reversing and going back to a desert because we are in a semiarid place. The life expectancy of the Bow is not meant to last beyond 50 years. The Elbow is pretty close to that as well because they kind of come from the same source. Fifty years is just a generation and a half really, so now we have to think what about those seven generations. Our great great grandchildren are going to say "Gee, our ancestors really didn't think about us too much did they?"

Possible Actions

I think one of the first actions that could be taken in order for positive dialogue would be the removal of regulations. If we could set those regulations, those policy images aside so you're inviting discussions, you're inviting input, and you're inviting interests into this dialogue... If that were to take place you would find far more input, ideas, from the First Nation side. We have two worlds. One is the spiritual world; one is the policy and regulation world. I believe at the end of the day what is going to save us is the spiritual world.

… We do need to establish a working relationship with all the non-nation people that live around us. Everybody is here to stay; there is nothing we can do to change that. Value systems with our younger generations are going to be more influenced by the dominant society. We need to maintain a sense of our own identity but give them the strength to work alongside a lot of non-native people.

Barriers to Action

Water is for us to share. Water is to be shared not regulated. Regulation means you can only do this. But we know we have to take care of it. We have to have some planning and policies are very rigid.

It's wading through the red tape. We were going along pretty good up until last summer and then legal got a hold of it on both sides and that just put the brakes on it right away because you just have to wade through all the legal stuff. We're back on track now since December. For about six months it just had to take a slow time through legal.

There's a lot of trust issues that had to be dealt with, that had to be addressed. There had to be a little bit of blood letting, we had to have a little bit of a fight and get our noses bloody and realize that were still fighting for the same thing. So there has been a big area of cooperation that has happened.

Aids to Action

We recognize the importance of dealing with the municipalities around us, dealing with the City of Calgary too. So with one of the municipalities to the north of us, we are starting to explore the idea of setting up a utility company where we could handle a lot of the wastewater and look at spray irrigation for some of the wastewater after tertiary treatment and membrane treatment. Spray irrigation, recharging the aquifer, wetland restoration...

Ideal Outcomes

Well I think the biggest issue is to make sure that we have water for the future. All the stakeholders need to be aware of this, need to participate, need to plan. A sore point with the First Nations is they feel they haven't been consulted with… maybe by a meeting and that will hold as a consultation process. The First Nations do take exception to that. A lot our lands, the rivers, and the river water basins are in traditional first nations territories. We're stakeholders just as much as anyone else. We need to identify the sources of water. We need to identify the potential environmental impacts and of course and the end of the day, not only First Nations, but we all need to make sure we have fresh, healthy water, sustainable and that water is there for the future.

If there was a perfect world I think...I would like to use our approach. All of our meetings start with a prayer and we ask the Creator to give us the strength to meet the challenges of a meeting, to be aware of the words we use and our actions, and we respect the other side... And to give all of us in the room the strength to live up to our responsibilities and at the same time we pray for our health, we pray for the health of everyone, the elders the youth. Give us the strength to lead a good life. Historically when the Bloods met with the white man, it was on the basis of cooperation, acknowledgement, so we offered the pipe, the peace pipe. And we believed that in order for talks or discussions to start, we smoke the pipe. So… you're held to your word. The shaft of the pipe is straight so what you say must be straight and true. When you inhale the tobacco, you exhale it upwards and you are asking for strength. So what comes out of you is integrity and honesty and the truth. I don't know if our politicians or policy makers would be...if this would acceptable to them because it's so far removed. So in a perfect world that would take place. And in a perfect world I would draw from you your interests, your concerns, your position, your values, and others. Then I would have the opportunity to share those, my values, my interests, my concerns, my philosophy with you. So I think if that process were to take place like that, not only would we find that we have more in common that we think, it would lead us to more peaceful environment. We would all certainly be more aware of what's at stake.

In order to salvage or preserve that resource, we're all going to have to come back and adopt a philosophy that speaks to the sacredness of that resource. Whether it's your philosophy or my philosophy, but we have to find a common ground because that's all we have and that's all we're going to get.

Any kind of stewardship or any kind of conservancy that we are doing on the reservation here, we have to think as far ahead as the seven generations after we're here and if the things that we are doing here aren't going to satisfy the needs of that seventh generation, then we aren't doing enough. It's kind of a native philosophy that is common throughout North America. And it makes you think forward, ahead into the future.

Source: Interviews with CBEM stakeholders.

Table A.9
Industry Stakeholders' Views

Problems
The basin has been over-allocated and over-used for a period of years.
Cause of Water Problems
You can't get any more extraction licenses for surface water… People are going to go to ground water more and more, and it's a more challenging resource to manage than surface water. What about protecting water quality? This gets back to municipalities. This gets back to any industry that has the potential to impact surface and ground water...that could be anything from fertilizers, pesticides, you name it. In the cities… we use salt as an ice control measure and as a society we have said that's an acceptable risk... You put it on the streets, it melts, and it ends up in the water. As a society we've said that's acceptable… I think to actually protect the ground water and the surface water, one thing we need to look at is areas where we either restrict development or we're very specific about certain types of development in those areas. To protect water quality...society has decided certain "run off'," in this case salt, is acceptable.
Consequences if No Action
The issues with water would be even more difficult to deal with. Our stakeholders would be much more concerned with how we are using our water. … Unless people start looking at both resources, both ground water and surface water, as a water resource, unless they start trying to manage that resource and knowing the interactions between those resources, they're not addressing the whole issue. They are not looking at the basin as a basin. They are looking at the basin as a bucket. Any drought would have severe impacts on the basin.
Possible Actions
Everything is a compromise. This gets back to the idea that if as soon as you discuss something with somebody you're moved off your original position... your initial needs or wants weren't met and I think that is where people have to be creative in addressing these issues and part of that is going to be knowing what the issues are, knowing what is significant and knowing what is now... If we see a place where we can improve our practices we do… and it's also in our corporate constitution to behave ethically and responsibly. We've got a water inventory program that we kicked off last year. We have individuals like me. I talk to health units, I talk to regulators, and I talk to stakeholders. I try to disseminate information, right or wrong. The thing is I try to give people information resources and try to give them the best information that I know of and let them make their own decisions. From that perspective, I think we are behaving quite responsibly with respect to water issues. The other things we are doing is we fund research projects looking at water, we contribute either in kind or in direct donations to groups that are active in water activities. For the last few months we have been in discussions with some of the water basin pacts in the province and we give money to some of the water stewardship groups. We try and participate. We're doing a pretty good job. More resources and commitment from the province is needed… primarily money and people. … use saline water and reduce the amount of freshwater we use in our operations.

The province should be the leader and allocate resources to get basin advisory committees set up. The province needs to provide resources to them so they can better study and understand the problem.

… we need to look at our water inventory. We have to know what we have before we can figure out what to do with it. It's common sense... you can't treat a basin like a surface water issue. You have to treat a basin like a groundwater and surface water issue.

All users of water have to be held accountable for their actions and behaviors. I'm going to be very clear on this...I think watering lawns is stupid... Why on earth would you do that? There has to be some way where, as a province, we can go back to individuals and say the way you are using water is, I wouldn't say unacceptable but it is ill-advised... What you do is you say there are four people living in your house and a reasonable amount of water use is 250 liters a day, 300 liters a day per person. As soon as you go over that threshold we are going to charge you more, there is going to be a surcharge on water. That's one way to do it, and metering, which the City of Calgary has done. You could start metering domestic watering wells. There are lots of different ways you could go about it.

Barriers to Action

The way the current regime is set up in the province right now, you have a large number of people that can access ground water and they have every right to. They can use up to a certain amount, like 1250 cubes a year, and they don't have… licenses or anything like that. Above that threshold they are supposed to get a license to extract water. You can make some ballpark estimates of how much groundwater you're using, but you can't really get a hard number. It is very difficult [to determine] what the extraction pressure is on the groundwater resources.

I think we don't have a good handle on the water capacity of the basin. We don't understand all of the major sources of water in the basin. We don't understand what the in-stream flow needs are. We don't understand the volume of groundwater and how it discharges into the basin, so we don't have a good feel on the overall water in the basin.

There is a lot of misinformation going on about what's significant with respect to water resources and water quality, and I think education and access to information is a very big issue.

People don't like being told what to do. There is a real political downside to imposing something on people that they feel shouldn't be imposed or that they feel that it's their right to access water. You talk to certain individuals, they figure they have the right to put a hole in the ground or put a hose in the river and take as much water as they want. So there is a political downside to it.

Aids to Action

Alberta has made a really good start with the Water for Life strategy. There are a number of basin advisory committees that have been set up.

There's more public awareness to the issues. The oil and gas industry is now focused on those types of concerns I guess. The oil and gas industry has been expanding quite rapidly with respect to coal bed methane development in the more populated areas of Alberta. That raised water as an issue. There were a lot of concerns brought up from the United States regarding coal bed methane development, different geological setting and different regulatory regime but those concerns were transferred up here anyway. So the awareness is there… I think there is more effective communication amongst the stakeholders as far as transmitting those concerns… and sharing information. There is more proactive activity or groups related to environmental issues, stakeholders groups, NGOs like the Panda institute...you know they've… been around for a number of years but they are very involved now in oil and gas issues and in agricultural issues – they're a pretty broad-based… organization. I think that people are more empowered to address issues a little bit more than they were before.

The province should be the leader and allocate resources to get these basin advisory committees set up. The province needs to provide resources to them so they can better study and understand the problem.

Ideal Outcomes
I'd have some sort of system where you had to ensure that the water that is in your control or you are the steward... you are accountable for protecting that… this gets back to either having a bad well that you have to fix or you are extracting too much water from the aquifer. A basin advisory committee with all major stakeholders would work together to manage their water use.
Metrics
There needs to be a measure of how we manage land in the basin. There needs to be a track record of how many acres of wetlands have been created or destroyed. Look at populations of fish and how they have been increasing or decreasing in the area. I think that the indicators that we use have to be technically based and have to be measurable, consistent and understandable. As far as water quantity goes, that's a pretty straightforward measurement. Everybody has a pretty good grasp of what volume is and how much they are using over a certain period of time. As far as water quality goes, that's really tough. You can go to most people and say you have this nitrate concentration in your water and they'll go "Is that good or bad?" And you say well, it's above guidelines but they don't know if it's good or bad. And even it is above guidelines is it really all that bad? Well, not in the short term. That kind of education… and understanding needs to be out there. As far as water quality, again it has to be prefaced by some sort of education because I can measure all the water quantity in the world but unless you understand or trust me to put this in front of you and say, here's the information, is it good or bad, is it acceptable? Until there is that education I'm wasting my time.

Source: Interviews with CBEM stakeholders.

Table A.10
Agriculture Stakeholders' Views

Problems
The biggest problem we have is nutrients and therefore aquatic weed growth in the river system and in the canal system because of the nutrients, which then takes oxygen out of the water. The D.O [dissolved oxygen] level can be low, from a fish habitat point of view. The concern is water quality, because of all the development in the City of Calgary and around the City of Calgary. When you have a million people living upstream, and industry and cattle operations, you can't help but feel that maybe the water isn't as clean as it should be. We've always had an abundance. We've never used it all. With the recent droughts, we've found out that there isn't an endless supply. With the glacier shrinking, we can see that there could be an end to it. We would not typically use our full license in most years, because it is supposed to cover water needs in the driest years. The problem is in the driest years there is not even enough water to get our full licensed amount out.
Causes of Problems
A big concern all over the world right now is climate change. "Are we having a climate change situation?" is no longer the question. The cause of the change is the concern. Is it man-made as a result of man's influence on the environment such as burning of fuels, is it only due to a cyclical situation that has nothing to do with us, or is it due to the increase in world population? Let's face it; 50 years ago the population was 3.5 to 4 billion, now it is close to 7 billion. We convince ourselves that in the need for industrial development, for houses... that nature can take a back seat. I don't know how many more years we can do that, especially in a basin like this, where we're seeing glaciers shrinking in the mountains. There's a realization by a lot of people that we have to be very cognizant of this resource. Population explosion for us is urban sprawl. For instance, take the City of Lethbridge. When I was a youngster, the west side of Lethbridge was a non entity. Now everybody has gravitated to Lethbridge. I worked in Calgary during the 1960s, at that time a city of about 187,000 people. In 40 years, it has increased almost tenfold. The infrastructure, roadway system, water system, the storage capacity of the Glenmore reservoir has not changed. The flow in the Bow River with the exception of that due to climate change has not changed. There's a demand on the system that was not there previously. Oil industry is using it [water] to drill wells. They'll need water for their drilling operations. There are demands that are on our watersheds. Everybody is using the water… Cities need it to run the cities. Businesses, industries are using the water and that's affecting the water quality.
Consequences if No Action
As water gets scarcer, we're going to have more disagreements. It could get to a point where they would have to curb development in this area if we did not either better manage our resource to utilize more of the water in the system or reduce the amount of water being consumed by current industries. The worst case scenario would be that we would not have good quality drinking water and that we would not have water to irrigate our crops. Because we have an expensive infrastructure with pivots and so forth, if you don't have the water and you go back to farming dry land, that would be a huge

loss in this area.

If there's no action taken, then we are going to have times when we are short of water in late summer. The glaciers on the Bow are receding. They don't provide a very large quantity of water, but they do provide water in the late summer (August and September) months. In a drought period when there isn't much else, that's a significant amount there. If we lose [the glaciers], that time of the year could be tight.

Possible Actions

The Water for Life Strategy is a good starting point, and there's a lot of things in there that need to be implemented. At least there's a realization that this is, that this may be a finite resource... There's still a lot of education to be done... still a lot of people that have to be made to realize that this water is not an increasing resource, let's put it that way.

The resources I have to use is as much as possible, implement new technology for monitoring water usage. I suppose a good resource is understanding my environmental footprint. You know, people tend to believe, what kind of shape am I getting this water in, but they don't think of what their activities are doing farther downstream. So maybe that's a good answer: the resources I should use are whatever I can get from different levels of government or… civil organizations.

We're on the right track with [the Water for Life Strategy]. We need to fund that adequately...

For instance on my farm, I am irrigating more acres with less water quicker than my father did.

We all become water conscious in the whole basin…

Getting resolution around the allocation, particularly for the natural flows or the natural requirements, will be important.
The province could buy an existing hydropower reservoir or two, or make a deal to operate them not just for hydropower, but to optimize flows for all purposes.

Irrigation has expanded. We've diversified and expanded and we have now reached the limit of the growth we can do as a result of the cap from government regulation since 1991 in this portion of Southern Alberta. Now with the Water for Life Strategy, there's been a lot of changes in how we do business. Technology has evolved from the stand point of going from flood irrigation, which is the norm in most parts of the world. We've gone almost exclusively to underground network distribution.

It's a matter of being more efficient with our system if we want to irrigate more acres. If you don't want to irrigate more acres, still be more efficient so in the drought year there's more water for everybody.

A lot of times we see people that are high profile either politically or movie star types...they jump on these bandwagons without all the facts. There is always going to be that conflict but just let them come and spend a day with us in this industry. Give us their ear just for a short time, and we can open their eyes.

When you have a province in a boom like this, the planners are almost like the last people to know what's going on and they should really be the first. Or the community or the politicians in charge of the municipal area should be really saying this area is reserved for development, this area is not. Design all of your facilities and your support for this.

… If we are going to continue to grow we are going to have to… divert better and… we have to look at storing more.

We do testing as far as water wells and we do our springs and stuff. At this point, we don't test this irrigation water coming in. And potentially, we need to start doing that.

Barriers to Action

As far as obstacles, it's just a money thing...it requires a lot of money.

The economics in agriculture, that would be number one. For all of us, it does not matter who you are, how big a farm you have. Everyone is in the same economic squeeze of low commodity prices. It's not so much low commodity prices, we have very high input costs in relation to what we're getting for our products.

There is a certain group that wants to protect "the environment" and then you've got another group that are perceived as those that want to make a living and want to build areas for people to live—cities, towns, villages, urban environments. … The conflict… has been that… some feel the water is best left in the river so that the ecology or the ecosystem of the river can be intact and all of the plants and animals and organisms and microorganisms can continue to flourish—and the trees, the cottonwood trees, etc.—within the river valleys. And then there is another group, of which I am a part… that thinks it is almost religious that water is placed into the rivers and that water should be used to enhance man's abilities to look after himself.

The province I think has been managing paper, not managing the resource.

I think the barriers are the same ones they are always in a situation like this: people's lack of education, people's lack of understanding, people's lack of admitting that there's a problem or not a problem.

Biggest barrier is likely some environmentalists feel storage on the river, any river, is a negative. Natural is best. That's probably the biggest barrier, from that point of view, getting the public to understand that there are pros and cons to dams on rivers. There are cons, I'm not saying there isn't, but there are pros as well and if it's done right I think they outweigh the cons. We couldn't sustain the people who live in Southern Alberta today if there were no reservoirs on the rivers.

We ask the public, who are totally ignorant of the facts, to give their opinion, which of course they're all confused like everybody else. And the industry really has no guidance, no planning, and no forward look. I think that's scary.

Aids to Action

This area… in Southern Alberta, is used to drought. We already have systems in place. When water became scarce, we said, yeah we have to have cutbacks. The farmers, we had meetings and said we've got a drought on, and everybody consciously started taking care of the water more and treating it like it was scarce. It's amazing… if you let people know the situation, people respond.

Calgary has gone to a zero wetland loss policy. What you'll see there is developers actually trade wetlands outside of their development a little bit, where it makes more sense than right there in amongst the houses.

It's called Alberta Environmental Farm Plan Limited. It's a limited company and it's actually run by a board of directors. Actually, I am on the board with this, just as of last year… it's a voluntary organization and it encourages farmers to do their own environmental farm plan.

Like I say, at the worst, we've become more responsible as a society and are not allowing the minimum flows to get down to the ridiculous levels they were. Some of that is voluntary, some of that's legislative, but I think we're taking better care… than we were.

We've seen fish recover in the river system, a better fishery, and improved habitat for wildlife... Improved water supply downstream. So those kinds of things have really been improved with the construction of the Oldman River Dam.

There's an incentive. A lot of farmers want to take this environmental farm plan because of the things they can obtain for their farm.

One of the things with the drought, with water shortages, it's made us more aware of where the water comes from and how much there is of it.

Ideal Outcomes

We definitely need some storage on the Bow... to mitigate high flows for flooding, and to be able to release that water back into the river in late summer if these drought periods extend. Ideally, it would be nice to have enough storage to buffer one year to the next, to have at least enough storage to take the peak off the peak floods, and put it back in the river in the summer.

Ten years from now, if we are still able to meet the water needs of society, and do so without conflict, I will say we have been successful.

… You would have some storage operating on both of the big tributaries, say both the Oldman and the Bow, that would allow a better flow regulation to ensure that there's enough flow in there for all purposes, not just for irrigation withdrawal.

Communication by all is very important. You've got to get players around the table. But some players, by tradition, haven't been there and they don't particularly care to be there. You have to force them to be there.

We would like to see the government, and irrigation districts, the environmental people and the communities work together and find a way to allocate the water fairly and properly so that everyone, everyone's needs are met.

It would be nice to reduce human impacts as much as is practical. You know you can't spend every dollar that's generated on sewage treatment. But we should not be afraid of spending enough to guarantee that the rivers are healthy. And with other practices, we should be doing what we can to make sure that… whether it's agriculture or whatever, that we aren't having more impact than we need to.

Metrics

I think they do measure the water quality that comes into our district and they also measure the water quality amount and the quality of it going back into the river on the other end of our system. So they do measure that.

We do testing as far as water wells, and we do our springs and stuff. But at this point, we don't test this irrigation water coming in. And potentially, we need to start doing that.

Source: Interviews with CBEM stakeholders.

Table A.11
Environmental Stakeholders' Views

Problems
We see that in the Bow Basin, as well as in the cottonwoods, a loss of regeneration. The predominate issue in the South Saskatchewan River Basin obviously is water quantity, but we also have issues of water quality. We know that with the decline in water volume we're going to get a decline in water quality... because the decline in water flows is occurring at the same time that the population is increasing dramatically.
Causes of Water Problems
Agriculture intensity has gone up... with the falling beef prices we had ranchers who have had to double and triple their production because the prices have gone in half... so they are stressing out the land base. There has been more and more demand for water allocations to support growth, to support industry, to support agriculture, to support recreation. The population is increasing dramatically… and industrial uses, like feed lots and food processing, irrigation, and industry have increased markedly. We're getting to a point where we could have a perfect storm... You also have to consider climate change. With climate change, while they may not allocate more water, there is likely to be less water in the streams anyhow. What water there is left after the allocation will be under further stress and cause further problems for the ecosystem. We know whether people like it or not that we've experienced an average climate increase of I think it's 2 degrees in this area. It's been accompanied by a decline in precipitation, particularly in the winter snow pack, which provides the majority of the runoff in this region. What we've experienced is tremendous economic and population growth within the basin, so those "hand in hand" have created a premium market around real estate...especially riparian-zone real estate. You are seeing a lot of development increasingly in some of the more remote areas, and one might consider the most important areas in the watershed. I've observed a great increase in human population and human footprint in the basin. I've witnessed expansion of urban residential settlements, fragmentation of native environments due to roads and oil and gas development, and loss of native environment in the last couple of decades. We have more development, more people… and more consumption. Our population is exploding, our use of the land and water is exploding, and our impact on the earth's climate is increasing. The biggest problem is over-allocation. The government of Alberta has allocated too much water for too many uses. There have been more conflicts between different interests of our society. Environmental interests are more at conflict with development interests, landowners have more conflict with industry, and there's been more litigation.
Consequences if No Action
If you don't start to improve your water management system to create a more strategic approach, you

are going to create tension between groups.

If we go another 20 years without making some significant policy strides, we will end up with arguably 50 percent of our riparian zone irreparably damaged.

If oil and gas industry, forestry industry, agriculture and rural residential developments continue along the same path, that we have over the last decade, we are in for a major crash... How far along are we willing to allow this to go? What are we willing to change to reverse the trend? Do we want to see the loss of amphibians or grizzly bears? I think most Albertans will say no. I'm a firm believer that if we don't all agree there's a problem, we can't agree on a solution. We are still defining the problem and agreeing on the problem in Southern Alberta. The cumulative assessment tool will be helpful in quantifying the magnitude of the problem.

Water quality side... if action is not taken... cities continue to grow... we are stressing more, developing more and taking more and more wetlands out of the picture. We are developing up to the waters' edge and we are having an impact on riparian areas... obviously you are going to continue to decrease water quality throughout the basin.

If nothing is done to control it, I see a declining quality of life for residents of the basin, and not only declining environmental quality, but we'll have more incidences of health effects. We will have less attractive recreational environments. I think economic well being and ecological health are closely linked, so if our environment degrades, our economy will as well. It will not be an immediate effect but we will see that.

Possible Actions

We need much greater awareness, ecological awareness…

Right now, they would put a moratorium on taking any more water, withdrawing anymore from the South Saskatchewan River, except for the Red Deer.

There is a really steep learning curve in this province when it comes to understanding some pretty basic principles about water... Fortunately… a lot of people are trying to get the word out, so maybe we can get the population up to speed on these issues before it's too late.

You need to look at not just incentive-based or voluntary mechanisms, but also mechanisms that perhaps are regulatory in nature… where the government says there are lines in the sand to be drawn, that you can't exceed an environmental limit.

We need an economic framework. We need policies and incentives from government to encourage doing the right thing.

What we've got to do is look at more sustainable community planning.

We start by paying what the resource is worth, rather than just assuming we can waste it. Unfortunately, in our society, we seem to have the attitude that if something is free, it's worthless. So maybe we have to start metering the use of this water. I'm in favor of that as long as it is publicly owned and publicly regulated. That means that the government ... oversees this, not private people.

Climate change… obviously we have to take action as Albertans to try to reduce our contribution to climate, greenhouse gasses.

I think I would put a big emphasis on education programs to help inform people and to help people make the right consumer decisions.

Barriers to Action

It will be difficult to get all the stakeholders agreeing because everyone looks at the change in this equilibrium as a win or loss.

We have some legal and policy barriers. General inertia about change and a lack of awareness among individuals about how their actions affect the environment. There is also a misconception that somehow it is either the economy or the environment, instead of understanding that long term needs should be the basis. If we do not manage the environment well, the economy will be devastated because they are so closely linked.

The problem is that the government isn't demanding. If the government said you will sit at this table and you will figure this out, or we will figure it out for you, and then guess what? Everybody's going to come to the table.

Barriers... I hear enforcement all the time from my clients... enforcement... making sure farmer Bob is not dumping his manure in my creek... who is responsible for that? Alberta Environment? It that provincial or federal? We [need] to break it up there... to start with ...

There are lots of barriers—legal barriers, because in existing law once you have a license, you have it forever.

There are very strong political barriers. Farmers in this province, particularly irrigation farmers, carry a lot of political weight.

I've witnessed environmental interests being shut out of decision making processes; we're not recognized as having standing.

The government doesn't want to get involved in making those kinds of decisions. The reason government doesn't work very well is because they refuse to govern.

We still have a lot of people in this province... who basically don't know where their water comes from, and could care less. As long as they can turn on their tap and it comes out of the tap, they're fine.

Aids to Action

It's so important for us to have a dialogue… because people are not talking to each other enough. To basically start looking at where the opportunity is. So before we jump to tools, we have got to have those discussions.

It's basically people coming together and saying, for the better of the community, for the betterment of the larger community, for the people that live here, we can come up with a better solution.

Everyone needs to get involved in watershed planning. I am going to get up on my soapbox ... this is the tool to identify issues... so we know what the issues are... Bow Basin Council and the North Saskatchewan Watershed line are really two good examples of that... Bow Basin Council has been around for about 13-14 years... and it is a bunch of stakeholders who all get together and identified issues... everyone is very educated to what everybody else is about... it is not a finger pointing or non informed. Everyone is up to speed on everyone else's issues and challenges... Bow River Basin is a good example of a great watershed group that not only has identified their challenges but they are doing things on the ground.

Alberta Environment, Ducks Unlimited, Cows and Fish Program, Living by Water, Albertan Fish and Lake Society... there is a variety of education groups that I work with like Inside Education who are doing environmental education… There is a variety of education and variety of on-the-ground doing work side by side.

The Alberta Fish and Game Association has programs to protect our grass land community. Ducks Unlimited has the Green Wing Program for educating kids. Turtle Unlimited has Yellow Fish Road where kids are taken out and at every storm drain a yellow fish is painted…

We've got groups that are community leaders and are willing to start working with their neighbors to make these tough choices, but we are doing this in the face of tremendous amounts of science that supports incremental degradation.

Ideal Outcomes

I would try to instill in residents of the basin that the health of the rivers relate to the health of the landscape which in turn means a healthy… society. Everything we do is linked to how healthy our rivers are and what we leave to our children.

Planning and surveys that have been done so far show that Southern Albertans value their rivers, they want to have good water quality, want to ensure there are good flows in their rivers. So understanding that vision that we share, what are the indicators that we will use to tell us that we are moving in the right direction.

Have the public plugged in and involved on the watershed scale... assuming that there is watershed managing going on... also an informed and educated public... We need laws protecting the areas... we are developing a wetland policy, but we do not have laws for the riparian areas.

We would like to work in partnership with all of the regulatory authorities and all of the partners that have an impact on these water resources.

The ideal world is that we look at the quantity and quality of water. We start increasing our reclamation and reuse. We start ramping up what we are doing with on-stream and off-stream storage within the basin.

We want to see the rivers and watershed managed in a way that sustains its ability to continue into the future forever.

Metrics

It can be using biodiversity indicators, like we know that many species at risk depend on aquatic environments that link to the Species at Risk Initiative and indicators of riparian health.

Total phosphorous, total bacteria count, and pesticides... I prefer meta indicators... indicator of indicators... so provinces come with a couple of really good ones...

We set limits for point-source discharge from a waste water plant. We say that there is a certain amount of nutrient that we allow, like phosphorus, ammonia, or nitrogen.

The fundamental measurement is how good our water quality is, how healthy our aquatic ecosystems are. We would have to have an economy that can be sustained.

Measuring water quality is a whole lot different than measuring performance for water quantity. The system needs to ensure that it is appropriate to manage for the primaries that we set outcomes for...whether it's dissolved oxygen, temperature, or nutrient loading. It's at those outcomes that we set that we know whether we are meeting goals.

Source: Interviews with CBEM stakeholders.

Table A.12
Sample of University Stakeholders' Views

Problems
Southern Alberta is a very interesting region because there is a lot of agriculture… there is some concern about water quality, pesticides, pharmaceuticals that may come from agriculture, and the potential impact that may have on aquatic species. What happens if we don't do something? Well it's clear what's going to happen and what has happened. We've...already had fish kills… fish will die. If we run out of water or if the water becomes of such poor quality that it can no longer be used, not only for drinking but also for irrigation, we are all going to be in big, big trouble.
Causes of Water Problems
In Southern Alberta, there is a lot of pesticide use because of the intensive agriculture. There are many crops that are being produced here, and the type of agriculture we're doing does rely very heavily on pesticides. As we are concerned about chemical inputs we have other stressors in the aquatic environment. One of them is linked to global climate change… Water temperatures are increasing.
Consequences if No Action
If the regime continues to change as it is changing now, then some of these species might be at risk and of course when a species is at risk or disappears, that changes the structure of the whole ecosystem… and makes [it] more vulnerable to serious dysfunctions.
Possible Actions
I think we need to work together, be critical of the information we do get and that we do gather, and be open-minded. Whenever there is job creation… it slows down the critical assessment of the situation because Homo-sapiens are a very optimistic species. We'd rather hear good news than bad news. That's where education comes into place. We need education in order to really show that there won't be an impact. …There's going to be the education factor of people… learning that in stream uses are reasonable uses, that having healthy aquatic ecosystems is a good thing. I think it's important for government to ensure that we have a strong, powerful wetland policy. I think good exchanges between the government, the academics, and the private sector is very important... and rather than looking at each other as adversaries we should exchange information and help each other out. [We need] to do more… watershed planning, make plans, make them have some teeth, and then move to meet them.
Barriers to Action
Of course the monitoring is fairly limited because of the costs of the chemical analyses of pesticides, and so there are still a lot of knowledge gaps about what the exposure level may be in Southern

Alberta.

… One of the obstacles is that to get clear-cut data requires careful studies, careful analysis of the data, and requires a lot of time. The rate at which we are changing our environment is so fast that the research and the scientific input has difficulty keeping up.

There is a dearth of information, especially available information... There could be more clarity to help the ordinary person, or even the non-ordinary person, the university person, to understand the data and to use it.
Aids to Action

We do have some monitoring programs in Southern Alberta. I did get to know the people who work for Alberta Environment... the people who are in charge of water quality monitoring. We know there are pesticides in water, in the rivers such as the Oldman and Bow… we do have some monitoring done.
Ideal Outcomes

The responsible use of chemicals of all kinds, of pesticides and pharmaceuticals. If we use them in a controlled fashion and try to prevent them from reaching the surface and groundwater, we could have industry and economic growth as well as good water quality.

Source: Interviews with CBEM stakeholders.

Table A.13
Government Stakeholders' Views

Problems
We've seen a general deterioration in water quality… There is a concern that if the trend continues, we are going to start to see some problems in terms of aquatic life protection. There are certainly reaches within the basin where water quality and water flows have deteriorated to the point that we recognize there is a problem. Water quality... if you have a very small amount of water and a lot of inputs, particularly in a semi-arid climate with the type of precipitation we have here—hard rain, fast, comes in a short period of time, large volume which causes not much absorption and a lot of runoff. So water quality is obviously an issue from a municipal standpoint as well as an industry standpoint. Withdrawal and the run off of the ecological flow have affected the ecosystems and… we have started to see measurable reductions in flow regimes of the river. We're in a semi-arid climate... so we don't have a lot of annual precipitation. Almost all the water we receive here is runoff from the mountains, which is an important factor if you don't have a significant snow pack... I think the biggest issue down here is managing water in its limited context. The biggest issues down here are the diversion of water, period.
Causes of Water Problems
Population growth, intensive agriculture use, and pressures for increased irrigation in my opinion will come back and pressure Canada from a global water crisis. We need to manage this particular river very, very well. Intensification of livestock and irrigation systems... Those are good in terms of progress of the economy, good of terms in development of the area... in terms of people being able to stay in rural areas... not urbanization... but it is turning areas against each other. I don't think there's any doubt that we are going through a period of global warming. Probably human habitation and the style of human life have had some impact on that and particularly the use of fossilized fuels has contributed to that. In my mind there's no doubt that we are going to have to change our practices: we have to live within our environmental envelope. That isn't an option. You can live off your capital for a short period of time. If we take more water from the system than the system is replenishing with, then sooner or later you run out of water. Much greater demand for water by not only irrigation and agriculture but also by industry and municipalities and recognition that water resources are a limiting factor for potential for growth. The biggest issues down here are the diversion of water, period. Obviously when you have increases in population and increases in industry then you have an increase in need for water, I think those go hand in hand.

Consequences if No Action

If we do not do anything there will be more conflict… over-use and more conflict over (what) water is used for.

"Whiskey is for drinking and water is for fighting over."

We've seen a general deterioration in water quality… There is a concern that if the trend continues, we are going to start to see some problems in terms of aquatic life protection. There are certainly reaches within the basin where water quality and water flows have deteriorated to the point that we recognize there is a problem.

In the next twenty years if nothing is done to evaluate or manage our water better, we are going to see significant shortages occur.

Possible Actions

I would like to see accountability, but you can't regulate people to be accountable, they have to want to be accountable. So it's a matter of respect and thinking, which comes from education.

I think as a first step there needs to be more information.

We need more resources for the council and for all of the people who work on the watershed basins on a voluntary basis often to make sure that they have the right information, to make the most wise decisions... because it is so easy for the local level to say yes... we need water for this or that without taking a broader perspective. So I think we need to educate people on the whole issue so wherever they are they can take a broader view of where water fits in...

What could be done? If there were more resources to some of these folks... incentives, of course... there is no tie between saving water and the price of that water.

Irrigation districts are doing the best they can looking at water efficiency and water productivity and water conservation in their areas, which is a positive step.

Best Management Practices, by the people on the land, by the landowners, and the producers with the help of conservation groups, are needed.

Meetings of interested people, the stakeholders getting together to share information, finding consensus on the contentious issues.

We need to make sure that we are planning with recognition that we have a finite water resource.

At the customer level, all water is metered, we have universal metering. So we know what all of our 30,000 customer sites is consuming on a monthly basis. The meters get read monthly. And the bills—though the rate designs may not be perfect—the bills are related to usage.

Barriers to Action

Economics is always part of water development and management. If the price is not high enough for the crops and there are uses for the land and people cannot manage the water properly or get the full use out it.

We are limited by money and its role in the ability to get things done.

I have observed a very strong entrenchment in positions with respect to how the river has been managed in the past in a very defensive attitude to where it might be managed in the future.

As a municipal government there really is a lack of direction in the context of a framework for those discussions so occasionally you will witness strange decisions even back to back. So you may have discussion about the potential for implementing low flush toilets, mandating low flush toilets to conserve water, and then two or three council meeting items later approving a million and a half dollars worth of irrigation for turf along the edge of an arterial road way without recognizing that there is a connection.

We don't know at the moment how much is actually being withdrawn from all the acreages and all the land domestic use does not require a license... they are allowed under the water act up to 1, 250 cubic meters of water a year, but no one knows how much is being taken..

There is a knowledge gap on groundwater on the ability to use that for aquifer storage. There is a knowledge gap on climate change and how it is and will be affecting the resource.

When you really sat down to talk to the community leaders and decision makers, they had absolutely no awareness, knowledge, information, nothing, so they were making day-by-day decisions for a municipality that were going to bite us in the bum big-time later.

Aids to Action

Get as many people in the area as possible involved in the discussions about this. There were some strong groups in town who were expressing interest: environmental groups and others like that, so we brought them in as stakeholders. Then that evolved into what is now the Oldman Watershed Council and was mandated by the province as part of its Water for Life Strategy.

We have to empower those water basin councils and trusts and give them responsibility and resources to make sure they are effective. We have to have new ways of the river's dimensions in activities.

Organizations that are available and in place to foster stakeholder discussions including: Alberta Institute of Aerologists, Oldman Watershed Council, Alberta Water Council, Watershed Planning and Advisory Committees. There is a keen interest in water related issues.

The Alberta government has water as a priority and they are spending the money on research into water.

[We need] widespread political will to do this and widespread public recognition, like the people in Denmark... People need to realize the seriousness of the environmental issues.

The resources to achieve real work comes from volunteerism, people like myself who volunteer their time without pay and from the groups from the organization who volunteer their employers time.

People who want to get involved in water resource planning can get involved in environmental stewardship groups.

Metrics

… In 10 years, I'd like to see fish still living in the river, people still able to use their kayaks… and healthy trees along the river valley. I'd also like to see less lawn irrigation going on all day and everyday. I'd like to see every new house use low flow fixtures, and a healthy community that's expanding… that we're still able to grow the cities and the economy and a healthy irrigation industry, but maybe not as big.

We need more monitoring wells... and more water quality as well. On the rivers obviously... they already do quite a bit of monitoring on the rivers and we also want to make sure that the ground water is monitored adequately for impacts from pesticides, fertilizers, and other discharges... impacts from the oil industry as well...

I think [we need] a price on water for industrial use and metering of water so that we actually know how much is being used... so we can relate that to the recharge rates...

Ideal Outcomes

I have three ideal goals: restore industry and flow needs in all areas where already over-allocated; to make sure our rivers and streams remain healthy; and sufficient monitoring wells and sufficient measures to take action to prevent depletion of fresh water aquifers... from any reason on a sustainable basis... And we need a lot of education of the public, industry... so there is the right mentality to accept change before we get disasters... It's often too late or not too late before an emergency to take action. I would like to see sufficient education... and I think there is willingness there... but I think it will require a lot more effort.

We have to make sure there is enough water in the river for ecological services. These river systems afford us things that we can never provide for ourselves. We have got to reduce the contamination in these.

We have to make sure there is enough water in these rivers and second we need to ensure water quality.

An ideal solution to this, in my opinion, is far more enhanced data collection, better monitoring and tying all of these things into a more informed computerized assisted negotiation process on a ongoing basis with experienced interests and a broad range of domains working together to find out best to manage water over the long term.

I would like to see a well thought-out well developed integrated water management plan that everybody in the basin all stakeholders including commercial and developing companies and industries can buy into.

At the customer level, all water is metered, we have universal metering. We know what all of our 30,000 customer sites is consuming on a monthly basis. The meters get read monthly. And the bills—though the rate designs may not be perfect—the bills are related to usage.

We need more monitoring wells... and more water quality as well. On the rivers obviously... they already do quite a bit of monitoring on the rivers and we also want to make sure that the ground water is monitored adequately for impacts from pesticides, fertilizers, and other discharges... impacts from the oil industry as well...

Appendix B.
Stakeholder Narratives by Basin Geography

The interviewees were selected on the basis of their diversity of views and geographic locations. Diversity of stakeholders was pertinent in order to document how people in different parts of the SSRB report their future water use preferences and perceive the SSRB's priority management issues. A common expectation in studies of stakeholder preference for future water use is that a person's place of residence will influence that person's point of view regarding future water use in a region or, in other words, "where you stand depends upon where you sit."

To test that assumption, this study organized stakeholder perspectives by geographic portions of the basin: upper basin and mountain areas, mid-basin or cities below the mountains, and the prairie or lower basin in Alberta. Analyzing stakeholder perceptions by region did not reveal significant differences among stakeholder groups. Although differences among the geographic groupings exist, what is surprising is the degree of commonality in the stakeholder perceptions of problems and solutions. Comments are summarized in Tables B.1 through B.4 and then listed as quotations in Tables B.5 through B.7.

Table B.1
Common Narrative Elements Across All Regions

Problems	Degraded water quality Over-allocation of basin Decreased water availability
Causes of Water Problems	Rapid growth in urban areas Agricultural practices Climate change Lack of water storage and/or diversions
Consequences of Inaction	Damage to ecosystem More disagreements among stakeholders Limit to population growth Significant drop in water volume in the basin
Possible Actions	Comprehensive modeling of the river basin Create a dialogue among stakeholders Educate the public about water issues Incorporate sustainability into management plans
Barriers to Action	Inadequate financial resources Reach of government policies Misconception that "nothing is wrong" Distrust among stakeholders
Aids to Action	Water basin advisory groups Water for Life Strategy Academic research institutions Baseline data
Ideal Outcomes	All stakeholders participate together Implementation of a functioning water management plan Build a system that incorporates resilience and considers multiple, factors
Performance Metrics	Surveys of stakeholders' satisfaction with management system Baseline data Standard water quality tests for nutrients Water metering

Source: Interviews with CBEM stakeholders.

Table B.2
Upper Basin and Mountain Stakeholder Narratives

Problems	Deterioration of aquatic health in riparian zones Variable water levels "Hardening" of wetlands Dropping groundwater aquifer levels Poor water quality
Causes of Water Problems	Dams and diversions leading to low river flows Population increase Economic growth Development along the riparian zones Under-valuation of water Lack of water storage capability
Consequences if No Action	"Extreme events" likely to occur Significant drop in basin water volumes Declining groundwater table
Possible Actions	Search for "win-win" compromises Implement market mechanisms/water pricing Feedback systems for management practices Model the water system and experiment with various hydrological scenarios Improve efforts to conserve, reclaim and recycle water Implement regional planning Align conflicting government policies Reduce allocations of water
Barriers to Action	Stakeholders' fear of sharing information Prior appropriation Denial of current realities
Aids to Action	Collaborative management efforts Use of quality science Volunteer groups Previous assessments of cumulative effects Bow River Basin Water Management Plan Government outreach programs
Ideal Outcomes	Water rights allocated with environmental preservation as the primary goal Create a system that is adaptive in nature Adequate water storage that allows for extreme events Increased public awareness of water
Performance Metrics	Surveys relating to current management system Groundwater inventories and recharge studies Pollution and chemical levels Wildlife inventories

Source: CBEM 6 Upper Stakeholder Interviews.

Table B.3
Urban Stakeholder Narratives

Problems	Over-allocation among stakeholders Water quality degraded Few restrictions on water use
Causes of Water Problems	Population growth Climate change No enforcement of water licenses Land use changes Prior appropriation policies Industrial discharges Agriculture intensity
Consequences if No Action	Negative effects on ecosystem Cataclysmic events Increased water rationing Limits to growth Junior license-holders cut off Increasing number of water disputes
Possible Actions	Incorporate sustainability into management plans Educate public Groundwater and surface flow monitoring Wastewater or storm water management strategies Improved water transfer plans
Barriers to Action	Lack of public knowledge Prior appropriation allocation policies Financial resources not sufficient to fund research Inadequate understanding of groundwater Resistance to “leaving” water Government reluctance to act until crisis False sense of security
Aids to Action	Baseline data, monitoring Water for Life Strategy Watershed stewardship programs
Ideal Outcomes	Incorporate resilience and consider more than average annual flows Creation of “basin advisory committees” including all stakeholders Cities become “non-consumptive” users Adopt goals for a provincial water strategy that has broad acceptance
Performance Metrics	Valuation of water quantities Test water quality for nutrient loading In-stream flow records Individual water metering systems

Source: CBEM 10 City and Urban Stakeholder Interviews.

Table B.4
Prairie Stakeholder Narratives

Problems	Poor water quality Water quantity: basin is over-allocated with low in-stream flows Ecosystem is degraded Over-dependent on irrigation for crop growth
Causes of Water Problems	Population growth in the river basin Global climate change Industrial pressures Permanent water diversions Untreated storm-water runoff in the cities Growing water-intensive crops
Consequences if No Action	Basin will not be able to support development Natural habit for certain species will be lost More disagreements among stakeholders Farmers would be unable to harvest crops Irreparable damage to the river system Possibility of water rationing
Possible Actions	Use baseline testing Create an open dialogue between stakeholders Meter water usage Limit urban growth Educate the public on water issues Encourage farming low-water crops Establish priorities of water needs Comprehensive modeling of the river basin
Barriers to Action	Rigid government regulations and policies Legal processes Distrust among different stakeholder groups Financial resources Misconception that technology will “save the day” First Nations not properly consulted
Aids to Action	Water basin advisory groups Public support initiatives Government programs such as Water for Life Academic research institutions Ducks Unlimited educational programs

Source: Interviews with CBEM stakeholders.

Table B.5
Mountain Region Stakeholders Narratives

Current Problems
We're in a very strong resource area here where there are a lot of wells being drilled, and there are a lot of concerns over water quality. As you get into the lower stretches of the river, you start to see water quantity becoming the key issue. When I was a boy, we would often go swimming in the canals… The canals are not deep, are not fast in most places. But the water quality was fine. Now, I wouldn't, I don't even like...I would never even let the kids run through the sprinklers. You know, I feel that the water quality has certainly declined. We see a lot more algae in the water.
Causes of Water Problems
It is vitally important to maintain the viability of these aquifers, and that has not been occurring. That's a major change that I've seen. You can always speak about the larger population density as the City of Calgary has gone from, when I was 20, and everybody was coming to university here, the City of Calgary was probably 500,000 or 600,000 people (and that's including the outlying [areas])... and now it's doubled. We convince ourselves that in the need for industrial development, for houses... that nature can take a back seat… and I don't know how many more years we can do that.
Consequences of No Action
The Bow River Basin is fully allocated. As the City of Calgary continues to grow, as industrial uses continue to grow, and as recreational uses continue to grow, I think we're at a point now where we'll see a lot more... I won't say conflict, but I'll say lobbying for the usage of the resource
Barriers to Action
The problem is that the government isn't demanding. If the government said you will sit at this table and you will figure this out, or we will figure it out for you, then guess what? Everybody's going to come to the table. I think the barriers are the same ones they always are in a situation like this: people's lack of education; people's lack of understanding; and people's lack of admitting that there's a problem or not a problem.
Resources Available
The Water for Life Strategy is a good starting point, and there are a lot of things in there that need to be implemented. At least there's a realization that this is… a finite resource. There's still a lot of education to be done. Still a lot of people that have to be made to realize that this water is not an increasing resource. You need to look at not just incentive-based or voluntary mechanisms, but also mechanisms that perhaps are regulatory in nature. Where the government says there are lines in the sand to be drawn, you can't exceed an environmental limit. The science is going to be really important because we have to understand what the science is saying in order for us to come up with the best decisions. A precursor to making good decisions will have the right information at the table… and part of that is just basic baseline information, and part of that is the modeling.

Possible Actions

It's so important for us to have a dialogue… because people are not talking to each other enough. To basically start looking at where the opportunity is. So before we jump to tools, we have got to have those discussions.

The challenge is going to be to build in feedback systems so that we get the data that we need in order to make informed decisions.

One very point-blank way of looking at it would be pricing for water. Like you might start having…some sort of pricing mechanism for water. It might not be the same as other industries, but it might make more efficient use of water.

We do testing as far as water wells, and we do our springs and stuff. But at this point, we don't test this irrigation water coming in. And potentially, we need to start doing that.

We have got to start planning for global climate change. I don't know what we need to do exactly, but I know that we have to have contingency plans for low water years… and I'm not talking about drought years.

Table B.6
Urban Stakeholders Narratives

Current Water Problems
The biggest problem is over-allocation. The Government of Alberta has allocated too much water for too many uses. The predominant issue in the South Saskatchewan River Basin obviously is water quantity, but we also have issues of water quality.
Cause of Water Problems
We are getting about a third of phosphorus loading within the river comes over land from tillage practices and how we manage the landscape. There has been more and more demand for water allocations to support growth, to support industry, to support agriculture, and to support recreation. An emerging issue is that when I first started no one paid any attention to climate change. The river is fed by glacial feed and snow melt, so how climate change will affect our resource is an emerging issue to be dealt with. The issues around water quantity reflect around growth and the demands from industrial and commercial opportunity from that growth. There has been a lot of development or urban development that has also taken place. It is positive in terms of the economy. But in terms of some of the conflicts of water users or water managers, it has turned into a tight area.
Consequences of No Action
Population growth, intensive agriculture use, pressures for increased irrigation in my opinion will come back and pressure Canada from a global water crisis. We need to manage this particular river very, very well. As a result of our failure to change, we will end up in a wholesale dispute and an unproductive conflict over what water should be for and who has the right to use it. What happens if we don't do something? Well it's clear what's going to happen and what has happened. We've...already had fish kills. If we keep going on, fish will die. If nothing is done, then we limited our economic development in Canada. If we go another 20 years without making some significant policy strides, we will end up with arguably 50 percent of our riparian zone irreparably damaged.

Barriers to Action

We are limited by money and its role in the ability to get things done.

A fairly major hurdle or challenge is to get people more information… impartial, unbiased information… truth about water.

Barriers... I hear enforcement all the time from my clients….Making sure farmer Bob is not dumping his manure in my creek. Who is responsible for that? Alberta Environment? Is that provincial or federal? We've got to break it up there.

We really don't understand what the interaction is with the water storage in glaciers, groundwater, and surface water.

There are lots of barriers—legal barriers, because in existing law once you have a license, you have it forever.

There is really strong government resistance to allowing private parties to hold instream licenses. One, it's just...I think it's just a conceptual problem they have. Thinking about having a license to leave water in a water course… and maybe thinking about the problems of enforcing that priority.

Resources Available

I think the big role played by irrigation districts elicits the need to get their cooperation to address and solve the problem is a valuable attempt at soliciting an important resource.

Alberta Environment, Ducks Unlimited, Cows and Fish Program, Living by Water, Albertan Fish and Lake Society... There is a variety of education groups that I work with like Inside Education who are doing environmental education, so there is a variety on the education side and a variety on the ground doing work side by side.

There are tools within our legislation that allow us to do some water management planning and strategic approaches to working with local governments to sort out how we manage the water.

Your allocation system, your water mastering, and your regulatory approaches have to be in place to get you to a desired outcome.

Possible Actions

We need more monitoring wells... and more water quality, as well… Obviously they already do quite a bit of monitoring on the rivers and we also want to make sure that the ground water is monitored adequately for impacts from pesticides, fertilizers, and other discharges.

We need to do some more… watershed planning, make plans, make them have some teeth, and then move to meet them.

I started to talk about integrated water resource management. I believe that you know, getting stakeholders at a basin, watershed group or we have now decided some basin sizes… that is an important step.

The government can also, when the water transfer takes place, hold back 10 percent of that volume transferred for other uses. I think that 10 percent is very small...I would like to see in every case... At least 10 percent if a water shed/water basin is already allocated, we need to make sure we are meeting the ecosystem needs.

Metrics

Total phosphorus, total bacteria count, and pesticides... I prefer meta indicators, indicators of indicators. So provinces come with a couple of really good ones.

There needs to be a measure of how we manage land in the basin. There needs to be a track record of how many acres of wetlands have been created or destroyed.

Develop a balance sheet and income statement, imperfect as it may be, but start recording it. If your mutual fund came back with a bunch of question marks on it, you would do something about it. That is what will happen when people see this on the balance sheet and income statement with all of these unknowns. Then do the quantity measurements and reporting and the quality measurements and reporting.

Ideal Solutions

We have to make sure there is enough water in the river for ecological services. These river systems afford us things that we can never provide for ourselves. We have got to reduce the contamination in these.

The ideal world is that we look at the quantity and quality of water. We start increasing and ramping up our reclamation and reuse. We start ramping up what we are doing with on-stream and off-stream storage within the basin.

Three ideal goals: restore industry and flow needs in all areas where already over allocated; to make sure our rivers and streams remain healthy; and sufficient monitoring wells and sufficient measures to take action to prevent depletion of fresh water aquifers. We need a lot of education of the public, and industry, so there is the right mentality to accept change before we get disasters. It's often too late before an emergency to take action. I would like to see sufficient education, and I think there is a willingness there, but I think it will require a lot more effort.

In view of other major economic drivers, ecosystem values and recreational fishing values are truly sustainable. If you want to talk about sustainable development, if you do that right, you can do that forever.

Table B.7
Prairie Stakeholders Narratives

Problems

There were concerns being raised about the number of gastrointestinal illnesses we were finding, E. Coli and things like that… We couldn't explain where they came from. It was in Lethbridge and the surrounding area. People began to question the quality of the water.

We've seen a general deterioration in water quality… Water quality is generally quite good, but there is a concern that if the trend continues, we are going to start to see some problems in terms of aquatic life protection. There are certainly reaches within the basin where water quality and water flows have deteriorated to the point that we recognize there is a problem.

If we run out of water or if the water becomes of such poor quality that it can no longer be used, not only for drinking but also for irrigation, we are all going to be in big, big trouble.

In 2001, we did have to implement a rationing program for all of southern Alberta. We had very little water left in our reservoirs as a carryover from the year before. We had a very low snow pack, so we had to ration our people with only 11 inches of water per acre.

Causes of Water Problems

I have concerns of improper spraying of crop fields over top of irrigation canals. You know, the water going down. Airplanes spraying potatoes for blights, or whatever they're spraying.

We're in a drought in southern Alberta, and someone's telling you, "don't wash your car in the driveway" or "don't water your grass," but we're dumping huge volumes of water on root crops, well, I guess you've got to start looking at those types of things, and should be looking at developing drought tolerant cereals and those kinds of things.

As we are concerned about chemical inputs we have other stressors in the aquatic environment. One of them is linked to global climate change… water temperatures are increasing. There is no doubt about that.

I've observed a great increase in human population and human footprint in the basin. I've witnessed expansion of urban residential settlements, fragmentation of native environments due to roads and oil and gas development, and loss of native environment in the last couple of decades.

We've had problems with a lot of rain in the spring—a couple of summers in a row—a great deal of rain which has caused a lot of runoff to come off the land and get into the Ridge Reservoir... a lot of nutrients are washed off the land and can get into that reservoir. That can happen clear up to the source into the rivers. There are a lot of nutrient rich loads that will get into the system.

Consequences if No Action

As water gets… scarcer, we're going to have more disagreements.

I think if we don't deal with it now it will come to a situation the scarcities will become greater the competition will become greater over scarce resources. The battles will intensify.

Given the fact that water resources are likely to be more strained in the future, we appear to be moving into a warmer drier period in history and that's going to put more pressure on us. Degradation of glacier fields as well will be another important factor.

It could get to a point where they would have to curb development in this area if we did not either better manage our resource to utilize more of the water in the system or reduce the amount of water being consumed by current industries.

So if the regime continues to change as it is changing now, then some of these species might be at risk and of course when a species is at risk or disappears, that changes the structure of the whole ecosystem… and makes the whole ecosystem more vulnerable to serious functional problems.

In the next twenty years if nothing is done to evaluate or manage our water better, we are going to see significant shortages occur.

Possible Actions

Whether you agree with global warming or not, I happen to think that it is an issue and that certainly is contributing. People have always looked at water as a renewable resource. I think we have to change that feeling; we have to educate people that water isn't an infinite resource. Water does have limits and should be treated as we treat oil and gas, looked after and respected as other resources.

I would like to see accountability, but you can't regulate people to be accountable, they have to want to be accountable. So it's a matter of respect and thinking, which comes from education.

There are some good things that city council over the last five, six years has adopted. They do take an interest in watershed protection and we invest a lot of time and money in the multi-stakeholder approaches in looking after those interests and recognizing that we as a community have a high potential impact in the context of wastewater treatment.

For instance on my farm myself, I am irrigating more acres with less water quicker than my father did. However, that doesn't mean that, you know, we still [don't] have to make improvements.

The way we manage water will be very important to the future of Southwestern Alberta, and we can't make it community by community. We need to be making decisions on a regional basis and even on a watershed basis.

We start maybe paying what the resource is worth, rather than just assuming we can waste it. Unfortunately, in our society we seem to have the attitude that if something is free, it's worthless. So maybe we have to start metering the use of this water.

Barriers to Action

As far as obstacles, it's just a money thing...it requires a lot of money

We need governments that are committed at the provincial and federal levels. At the federal level we've had governments for some time disputing whether it is necessary to meet the Kyoto Protocol because it was going to be too expensive. But we are talking about water management in the long term. It doesn't make any sense to give the excuse that this will be a good thing but that it will be too expensive economically. It is not too economically expensive because there is no other economic development alternative.

There is a certain group that wants to protect "the environment" and then you've got another group that are perceived as those that want to make a living and want to build areas for people to live—cities, towns, villages, urban environments. And so the conflict I guess has been that…some feel the water is best left in the river so that the ecology or the ecosystem of the river can be intact and all of the plants and animals and organisms and microorganisms can continue to flourish—and the trees, the cottonwood trees, etc.—within the river valleys. And then there is another group, of which I am a part of that thinks it is almost religious that water is placed into the rivers and that water should be used to enhance man's abilities to look after himself and provide a living.

One of the obstacles is that to get clear cut data requires careful studies, careful analysis of the data, and

requires a lot of time. The rate of which we are changing our environment is so fast that the research and the scientific input has difficulty keeping up.

We ask the public, who are totally ignorant of the facts, to give them their opinion, which of course they're all confused like everybody else. The industry really has no guidance, no planning, no forward look. I think that's scary.

Aids to Action

Get as many people in the area as possible involved in the discussions about this. There were some strong groups in town who were expressing interest: environmental groups and others like that, so we brought them in as stakeholders. Then that evolved into what is now the Oldman Watershed Council and was mandated by the province as part of its Water for Life Strategy.

There is a continued awareness. There are programs out there where they are trying to make people aware of the things they do, whether it's a livestock producer or recreationist, you know, to try to reduce the impacts on water quality.

The Alberta government has the Water for Life Strategy and Natural Resources Conservation Board have been put in place by the Department of Environment of the Alberta government. Their role is to police and to monitor quality infractions.

We are still involved in water quality concerns and water quantity and looking to how we can provide the future needs of water in the basin. So, every river basin in Alberta is setting up a watershed council in order to take care of the needs of all water users in the basin.

There was quite a bit of baseline work done about 15 years ago by Alberta Agriculture in looking at the water quality coming into the district and leaving the district.

Ideal Outcomes

Well I think the biggest issue is to make sure that we have water for the future. All the stakeholders need to be aware of this, need to participate, need to plan. A sore point with the First Nations is they feel they haven't been consulted with, maybe by a meeting and that will hold as a consultation process. A lot our lands, the rivers, the river water basins are in traditional First Nations territories. We're stakeholders just as much as anyone else. We need to identify the sources of water. We need to identify the potential environmental impacts and of course and the end of the day, not only First Nations, but we all need to make sure we have fresh, healthy water, sustainable and that water is there for the future.

So that's what I would see as an ideal future. You would have some storage operating on both of the big tributaries, say both the Oldman and the Bow, that would allow a little better flow regulation to ensure that there's enough flow in there for all purposes, not just for irrigation withdrawal.

Ideal in 10 years, I'd like to see fish still living in the river and people sill able to use their kayaks and things like that and healthy trees along the river valley. I'd also like to see less lawn irrigation going on all-day and everyday. I'd like to see every new house use low-flow fixtures, a healthy, community that's expanding, that we're still able to grow the cities and the economy and a healthy irrigation industry, but maybe not as big.

Ten years from now, if we are still able to meet the water needs of society, and do so without conflict, I will say we have been successful.

If we could actually sit down and say that everybody is on the same playing field, that nobody else is giving any more authority or rights than someone else, then we can usually come to an agreement.

In an ideal way, we will match our development to water supply that takes into account reasonable

minimum flows in the river system, as our understanding of aquatic ecosystems and biodiversity improve. My ideal will be to try and reach that balance whereby we understand that achieve a balance between ecosystem needs and economic development.

Metrics

I look for the obvious… poplar trees no longer grow downstream of where I live. The river does not freeze over like it used to. We used to be able to drive over the river because we didn't have a road so we would hope the river would freeze so we could get into town. In my area, one species of fish is no longer around, the grayling fish.

There are a variety of techniques, one being in-stream flow needs, which helps us understand what the volume of flow over a period of time must be for a river.

The fundamental measurement is how good our water quality is and how healthy our aquatic ecosystems are.

Appendix C.
Stakeholder Interviews

A key element of this study was the effort to solicit anonymous interviews from diverse South Saskatchewan River Basin stakeholders that could identify a range of choice in future water uses and priorities. The graduate students within Policy Research Project offered each of the 42 stakeholders from throughout the South Saskatchewan River Basin in Alberta anonymity in exchange for their perspectives. After the interviews were completed and evaluated each participant was offered an option of being associated in this report with her or his individual perspectives. Some interviewees consented to be listed by name while others preferred to remain anonymous. This section reports the summary of each interview with stakeholders, listed in alphabetical order. UT graduate students wrote brief descriptions of each interviewee to indicate her or his priority concerns. Anonymous interviewees are listed as a group at the end of this appendix. Interviewees were asked if they wished to edit their comments to assure accuracy of meaning and intent. Comments have been edited for brevity and clarity.

Bill Berzins

Interview by Zac Simpson and Charlie Stern
Fossil Water Headquarters- Calgary, Alberta
January 11, 2007

Bill Berzins, an engineer by training, has been a volunteer on the Bow River Basin Council since its inception. He is the CEO of Fossil Water, and has been involved in environmental protection in Alberta for 15 years. He wishes to create a sustainable management strategy for the South Saskatchewan River Basin. Mr. Berzins would like to see a situation in which wastewater reclamation receives more attention because he believes that it could be beneficial in basin water management. He would like to see community water storage planning that could be used during extreme droughts and similar events. Mr. Berzins reports a number of significant problems in the river basin, such as a noticeable degradation of water quality in the river basin, especially at the confluence with the Oldman River. Mr. Berzins states that the surface water system in the basin is currently fully allocated, which presents problems for future growth. Population growth is not only a future concern but is also a current contributor to stress on the surface water system. From population growth, economic growth increases the nature of usage that the river basin as been expected to support. Another cause of water quality and quantity problems in the basin is the lack of attention to the cumulative effects of management decisions.

If nothing is done to address these issues, Mr. Berzins believes that degradation of the river system will continue and eventually reach a level that will not be able to be reversed for many generations. Reversing such damages will be a costly procedure that might not

be effective. In order to address the situation, Mr. Berzins wants to improve efforts to conserve and reuse water through techniques such as wastewater reclamation. He believes that regional planning is an excellent management strategy to address water quantity and quality in the basin and should be given the decision-making powers necessary to take action. He would also like to create an economic framework that promotes and rewards good environmental stewardship.

Mr. Berzins believes that there are a number of barriers that might preclude effective actions. One barrier is that there is not a clear linkage between economic and ecological incentives in the management of the basin. Another issue is that there is no "silver bullet" that will solve all of the problems, which could undermine the level of stakeholder dedication in the consensus building process. Mr. Berzins did suggest a number of resources that could be employed to promote better management of the river basin. Mr. Berzins believes that volunteer and research groups need adequate funding to be effective in their goal of addressing cumulative effects in the river basin. Mr. Berzins suggests that previously completed cumulative effects assessments could be a used as a benchmark in the current situation. Mr. Berzins ended his interview with the suggestion that performance measures are important and that a "balance sheet" could be developed to report on the river basin's quality and quantity.

Problems:

- Degradation of water quality in the river system, especially at the confluence with the Oldman River
- Dropping aquifer levels show that subsurface water and surface water in the basin could be inter-related

Causes:

- Population growth places stress on the river system
- Economic growth in the province increases the different activities that affect the river basin
- Development along the riparian zones in wetlands and recharge zones adversely affect water
- Cumulative effects and managing to mitigate them

Consequences of No Action:

- Degradation of the river system that will effect many generations
- Costs to undue damage
- Declining groundwater table will be hard to reverse

Potential Actions:

- Improve efforts to conserve and reclaim/recycle water so that both water quantity and quality levels are augmented
- Implement regional planning as a water management strategy
- Integrate ideas of environmental stewardship into an economic framework for water planning
- Set objectives for water quality and begin reporting

- Align conflicting government policies

Barriers:

- There isn't a definite linkage between economic and ecological incentives
- There is no single silver bullet that will solve all of the problems
- Mapping development for the next 50 years could be difficult
- Political risk could occur for policy makers who stand up for proper management

Aids:

- Volunteer groups with adequate funding can assess the river
- Research groups with adequate funding can address cumulative effects
- Examine previous cumulative effects assessments
- Empower local leadership groups

Ideal Future:

- Sustainable community planning with adequate water storage that allows for extreme events
- Give more attention to waste water reclamation
- Consideration to both on and off-stream storage

Metrics:

- Incorporate some sort of "balance sheet" for baseline regional water inventories
- Need real-time price metrics to provide proper resource valuation

Cheryl Bradley

Interviewed by Nishesh Mehta and Elizabeth Ojeh
Lethbridge, Alberta
January 9, 2007

Cheryl Bradley moved to Southern Alberta in 1971 to work as a biologist with the Alberta Parks agency. Since then, she has been involved with issues concerning the Bow, Oldman, and Milk Rivers and their basins. She represented environmental interests on the Oldman River Basin Advisory Committee and served for several years as co-chair for the Urban Team for the Oldman Watershed Council. Her MSc graduate research focused on the downstream effects of dams and diversions on cottonwood trees concerning their riparian habitat. Cheryl is an advocate for protecting rivers and has an ecological understanding of southern Alberta rivers and watersheds.

Ms. Bradley would like to see more appreciation by citizens and key stakeholders of the water they use and the effects of their daily activities on the river basin that provides that water to them. A change in attitude, from denial to acceptance of the fact that water is a limiting resource and that our activities affect the quantity and quality of that resource, will hopefully prompt more people to get involved in conservation efforts at home and at work. Increased efficiency and productivity of the water used by the industries, including

irrigation agriculture, that consume a lot of water would yield savings that could be applied towards increasing in-stream flows within rivers that already are under ecological stress. She believes that environmental interests should be allowed to hold water licenses, and the allocations be used for environmental health and river conservation. She hopes there will be more cooperation among a variety of interests in the management of the rivers.

Ms. Bradley has observed the impact of increased human traffic, urban sprawl, and the fragmentation of native environments on the river system, especially in the last two decades. The community has moved from the denial of water as a limiting resource to acknowledging the challenges of managing the water resource to prevent shortages and degradation of riparian areas. She supported litigation when environmental concerns and interests were being shut out of the planning stages of the Oldman Dam project. The judgment handed down by the court now requires that the government carry out Environmental Impact Assessments, and consider other interests in planning major projects that affect rivers. She also led an appeal of a decision by Alberta Environment to allow an irrigation district to use water for purposes other than irrigation without returning any of their allocation to stressed rivers.

Ms. Bradley reports that government has been reluctant to legislate, believing that "planning is intervention," hence they do not act. Currently the government is getting more involved in river basin planning, especially in awareness programs. The government has mobilized to do more to ensure appropriate practice, either by way of policy, incentives or legislation. The use of the "cumulative effects assessment" model developed by Dr. Brad Stelfox can help in watershed planning by simulating the future outcome if all activities continue along the current trends.

Ms. Bradley observes decreasing pollution from point source effluents but increasing pollution from non-point sources, mostly from rainfall runoff in urban and agricultural landscapes. Thus, there is a need to educate people that the treatments (e.g. pesticides, fertilizers, bare soil) they apply to their fields or yards, can end up in the river, polluting it. Education programs should promote the use of environmentally friendly products and practices, be demonstrative, get to the grassroots and be continuous. The level of success can be measured using indicators of aquatic and riparian health.

Ms. Bradley perceives that some people believe that there must be a choice between either the economy or the environment, and that misconception also needs to be addressed. However, people should be helped to understand that economy and environment are linked so that long term economic well-being and quality of life cannot be sustained unless the environment is. Changing attitudes will be observed in improved water quality, healthier ecosystems, a sustainable economy and an increased quality of life.

Cheryl Bradley tries to educate people that the health of the river is tied to the health of the landscape/watershed and that of the society. She stated that how the river basin is treated now will determine the legacy of this generation to the next.

Problems:

- Fragmentation of native environments for various species
- Conflicts among different interest groups
- Gradual degradation of water quality and riparian health

Causes:

- Population and urban growth
- Environmentalists shut out of the decision making process
- Inadequate monitoring of non-point sources of pollution
- Water system (surface and groundwater) is complex and therefore difficult to understand
- High amount of water allocated to irrigation agriculture in Oldman River Basin
- Increased demand by various users such as oil and gas industry, urban and recreational usage

Consequences of No Action:

- Decline in the quality of life
- Negative health effects
- Basin would lose its attraction to people who would like to settle here
- Eventual economic decline

Potential Actions:

- Use of "Cumulative Effects Assessment" model in planning which simulates future scenarios and helps educate people on the failure of a "laissez faire" approach and the need to make choices that benefit future generations
- Policy changes that require environmental issues to be identified and addressed when land use and water allocation decisions are made
- Mutually defining the needs of all the users
- Creating awareness in the communities about how their day-to-day activities affect the river
- Use of water efficient appliances, shorter showers and other water conservation strategies
- Regulations and political impetus to include environment into mainstream decision making
- Development of environmental health indicators
- Development of sustainable indicators of quality of life, not just economic metrics
- Instill in the residents the stories of how the health of the community is linked with the health of the river

Barriers:

- Legal and policy barriers where environmental issues do not find expression in major decision processes
- Inertia against change

- Lack of knowledge on the part of users
- Government policy has been largely non-interventionist

Aids:

- Basin councils which act as forums for discussion among a variety of interests
- Change in water licensing practices which allow transfer of allocations
- New water treatment plant for the city of Lethbridge
- Cows and Fish riparian habitat Program
- Water for Life Program
- Acknowledgement of environmental issues as important by the provincial premier

Ideal Future:

- A common vision shared by all users and stakeholders of how and what aquatic ecosystems should be
- People become knowledgeable about various facets of water resources and appreciate the environmental links between them and their watershed
- Healthy and sustainable ecosystem
- Quality of life- healthy productive lives for people and incomes
- Development of the economy and conservation of the environment becomes a simultaneous process rather than an "either/or"

Metrics:

- Surveys reporting (a) how knowledgeable users have become about water resources or (b) stresses on the watershed
- Indicators of water quality
- Indicators of riparian health
- Indicators of biodiversity in watersheds

Kent Bullock

Interviewed by Emily Sentilles and Hilary Aten
Taber Irrigation District Office, Taber, Alberta
January 10, 2007

Background: Taber Irrigation district includes approximately 82,200 acres of irrigation (close to their allocated cap) and not currently in a crisis of water but in a crisis of management.

Kent Bullock is the manager of the Taber Irrigation District in Alberta, Canada. He has been the manager since 1989 and was previously the engineer for the district. He has a master's degree in civil engineering from Brigham Young University and grew up on an irrigated farm. The Taber Irrigation District has 82,200 acres of irrigation, which is currently the cap. To grow, a plebiscite of the farmers is required. However, the district typically does not use their full licensed allocation. It uses 158,000 acre/feet of water.

They have amended their license so that 8,000 acre-feet of water could be used for other purposes, including industry, municipalities, or recreation development.

Mr. Bullock sees the issue in the Taber Irrigation District as not being about the supply of water, but rather how they manage the resource. In his ideal situation for the future, he would like to see the district or Alberta capturing more of the river for storage in order to have a more secure water supply and less frequent drought. Capturing more water would allow the district to lower flood flows in the springtime and allocate more flow later in the growing season, which would allow agricultural expansion.

A current problem in the Taber Irrigation District involves not having enough water in the basin to supply the licensed amount during dry years. In 2001, the entire irrigation district cut back on allocations per farmer in order to meet the water needs of the surrounding communities and industries. Mr. Bullock reports few water quality issues in the river. There was only one year recently in which there were quality problems due to heavy rains that washed pollutants into the rivers. The most substantial problem is by the end of the season the water flows are low.

Water supply problems are expected to exacerbate according to predictions around climate change. Further, the river is currently restricted and closed to new licenses, indicating the full allocation of the river and the little room for growth and or shortages. There are more demands now currently on the Taber irrigation district for allocation of its licensed water. Mr. Bullock recommends creating additional storage for multipurpose use, decisions to share water, more efficiency in production and delivery mechanisms of the district, and a possible cap on growth. Storage facilities would allow Southern Alberta to maintain 50 percent of their allocated water in the river per the tri-province agreement. This allocation could provide for flood protection, habitat protection, and higher flows in the late growing season when the river typically runs low.

Some of the tools that are helping the irrigation district in this process include the knowledge they have gained from previous shortages and the improved quality of the Oldman River due to the Oldman River Dam. According to Mr. Bullock, the Oldman River Dam has led to improved water quality because it allows for more dilution, which has led to better fish counts and improved habitats.

Some barriers to better management, according to Mr. Bullock, include those who argue for more water in the river—fishermen, environmentalists—who want to maintain a natural state. Mr. Bullock believes there is a tradeoff between growth, development and the natural state of the river, and that all parties can work towards a compromise.

If management does not improve, Mr. Bullock foresees that the basin could be closed to further licensing and the existing licenses would have to do something different to meet future growth needs. As a result, the area would have to curb development if it could not manage or reduce the amount of water consumed. This could lead to change in crops as well as improved crop-water efficiency.

Mr. Bullock suggests metrics for measuring success and better management projects could include the irrigation types within the district (currently 4 percent of the district is

flood, 96 percent is sprinkler). Another measure would be the frequency of drought conditions, provided there is not change in climate. However, climate will always be variable.

Problems:

- In a dry year, not enough water in basin to cover licensed demands
- Can see another shortage of water in the future
- Had quality problems in 2002 because of heavy rains, but not usually many quality problems
- By end of season getting to low flows
- Flows not necessarily coming at right time because of earlier melting

Causes:

- Increasing demands on irrigation district from other sources
- Climate change—weather ahead could be more severe
- Snow pack melting faster in the mountains
- More intensified agriculture that requires fertilizers and chemicals could create more quality problems in the future

Consequences of No Action:

- Basins closed to further licensing; existing licenses have to change to meet further growth
- Need to shift crops of area—no more irrigated crops
- Would have to curb development if users do not manage or reduce the amount of water consumed

Potential Actions:

- Made decision to share water as in 2001 drought, Reduced consumption across the board in irrigation district
- More efficient production—also necessary because farmers do not profit until 90th percentile of their crop sold
- Increased irrigation efficiency because of pipelines instead of canals, low pressure instead of high-pressure irrigation
- Limits on growth as an option
- Wants a combination of increased storage and increased efficiency in order to continue growth and development, to have better flood protection and habitat protection
- Need for more efficiency to produce more crops or other irrigated crops

Barriers:

- Those who want more water in the rivers—fishermen and environmentalists who want a natural state
- Any growth or development will have an impact
- Time because it takes a while to build a dam

- Choice between economic development versus growth

Aids:

- Farmers learned better ways to schedule water from last drought
- Oldman River Dam has improved quality of river, from agriculture to quality to ecosystems

Ideal Future:

- Capture more of the river so that water supply is more secure
- Less frequent drought
- Lower flood flows in the springtime, increased flows later in season
- Possibility for agricultural expansion because of role in economy

Metrics:

- Irrigation types
- Frequency of droughts

Lee Crowchild

Interviewed by Marco Campos and Dr. David Eaton
Tsu Tsina Nation
January 10, 2007

Lee Crowchild works as the infrastructure manager for the Tsu Tsina Nation. The reservation is located on land 6 miles by 18 miles along the Elbow River, just west of the City of Calgary. Mr. Crowchild grew up on this reservation that has a population of roughly 1,400 members. At that time Calgary included only about half a million people. The Nation was very involved in the Calgary Stampede, which took place on the banks of the Elbow River. The Nation never thought much of not having water, as it was always available for fishing and swimming in the nearby creeks. However, traditional stories prophesied impending change and predicted that the situation would get so bad that water would have to be sold. The truth of the prophecies is found in the fact that the tribe now buys bottled water.

Mr. Crowchild noted that recently the flow ceased in one of the smaller creeks on the reservation. During the summer the creek now dries up completely, which historically has never happened and has led to a decline in the abundance of fish in the creek. Several ponds have dried up. The quality of the wells in homes, as measured by an increase in manganese and sulfur content, appears to be getting worse. Despite increased mineral levels, Health Canada still insists that the water is safe to drink. Mr. Crowchild notes that the water has a harder quality to it and the reservation now tests water quality more often. Residents of the Nation complain that the water is not suitable for household purposes, citing that the water ruins their clothes when they wash or that the water tastes bad or has a bad smell to it. Water has also become more difficult to locate, requiring multiple drilling of wells for households.

Along the Elbow River, the province's over-licensing has led to limited access. Because the river runs through the reservation, Mr. Crowchild stated that the Nation maintains it and should get as much access as it needs. Most of the licenses are held by water co-ops, golf courses, irrigation districts, and smaller businesses. The reserve has not been affected much by the growth of Calgary because the reservation is located upstream, albeit Calgary's growth has created a fight for water. The reservation has several water agreements with the city to bring potable water onto the reservation, but the expansion of these licenses is difficult and has led to conflict with the city.

Mr. Crowchild stated that planning and conservation should consider the present as well as the next seven generations. Some research he has projected the life expectancy of the Bow and Elbow Rivers as no longer than 50 years. The Nation does not have a strategy for conservation. Alberta did consult with the Treaty Seven area Nations to develop a water strategy. Mr. Crowchild stated that this consultation was a failure because a plan was developed by the province before the consultation took place. Alberta has placed a moratorium on water licensing in the lower Saskatchewan Basin, which could lead to a court action from the Nation. The Nation feels they were not properly consulted in the formation of water strategy and because they did not agree with the plan offered by the province.

Problems:

- Rivers drying up
- Decrease in fish populations
- Harder to locate groundwater for household use
- Water is hard, tastes bad, smells bad
- Political fight for water
- Decrease in frog population

Causes:

- Nature
- Oil and gas development

Consequences of No Action:

- Isolation
- Lost opportunity to gain knowledge

Potential Actions:

- Establish working relations with non-Nation populations
- Revisit historical treaties with the government
- Aquifer recharging
- Tertiary treatment of wastewater

Barriers:

- Trust issues
- Lack of government consultation with the First Nations
- Several government bureaucracy layers

- Legal processes

Aids:

- First Nations willing to cooperate
- Cooperative relations with municipalities

Jim Csabay

Interviewed by Nishesh Mehta and Elizabeth Ojeh
St. Mary's Irrigation District Water Commission, Lethbridge, Alberta
January 8, 2007

Jim Csabay has been farming and irrigating for 44 years. During that period, he has served in many leadership roles for irrigation districts and councils. He holds many offices in the agriculture/irrigation industry and is currently the Chairman of the Board of the St. Mary River Irrigation District, which serves 372,000 acres. Over the years he has observed a major shift in the way farmers manage their fields. He remembers the time when there were no storage systems along the river and water supply for crops was directly dependent on the season and the amount of water in the river. However, after the dams and reservoirs were built, canals were constructed to convey the water to the fields; the practice of flood irrigation was developed.

Now, the farmers have moved away from the old flood irrigation system to the use of underground piping, which allows for more efficient application of water to the crops and eliminates a lot of waste. The farmers are now starting to use meteorological information to determine when and how much irrigation water will be required, depending on the weather forecast available. They are also paying attention to global issues like climate change and global warming. Although they are not certain of the cause, they expect global warming to have consequences for farming, as it affects the amount and timing of precipitation in the region. Automated watering systems are also now in use to determine when crops need or have enough water. These are major milestones in the practice of irrigation as it involves large scale education and communication of information. Mr. Csabay states that this behavior indicates that farmers are also concerned about the environment and the land that supports their livelihoods, and would like to leave a good legacy to the coming generations.

Mr. Csabay agrees that as populations of municipalities grow, more water will be required by the communities and water may become scarce. Citing the 2001 drought as an example, he said that irrigators demonstrated their good faith by conceding about 50 percent of their water allocations to ensure all communities had water, and to keep the rivers flowing. He argues that most farmers will do the right thing by their communities but cautions against the use of legislation to enforce cooperation, as most people are averse to being forced. Legislation will make people try to find exemptions, he says, and might lead to litigation; persuasion through reasoning is better.

Though the quantity of water used by farmers seems so much to many, Mr. Csabay wants to remind them that it is for the production of essential goods which benefits society, and that farmers are doing their best to be responsible, and adapt to better management practices as they become available. Irrigation districts meet often to discuss and disseminate information to the farmers they serve and continually look for better options such as switching the crops they farm to other high yield crops that consume less water. Communication is critical to the management of the irrigation districts. Farmers partner with the Alberta Irrigation Projects Association and the University of Lethbridge in sharing information and to keep the legislature and administrators informed and involved in their activities. They try to collaborate and cooperate with all stakeholders to achieve compromises on the management of the river basin.

They also build liaisons, employ lobbying, and use the media to inform and communicate their challenges, and how they are tackling them. The community gets to hear their side of the story, and even help in proffering solutions like reporting any observed lapses in their systems, such as the flow of manure runoff from feed lots into rivers so that the system can be rectified.

Mr. Csabay would like to see more water storage systems put in place and the expansion of distribution facilities. He hopes that team solutions will be adopted in dealing with issues relating with water in the basin, so that all stakeholders can have inputs in the process. Growth in the basin could be measured using statistics such as population changes, Gross National Domestic Product (GNDP), or trade balances over time.

Problems:

- Shortage of water
- Stress on water resources
- Water quality may become an issue soon
- No quantification of the water used by golf courses and municipalities

Causes:

- Climate change
- Weather unpredictability since there is no monitoring mechanism
- Population growth
- Urban development
- Industrial growth

Consequences of No Action:

- There is no clear and present danger

Potential Actions:

- Impart education to people
- Quantify how much water is being used for various needs such as agriculture and municipal needs
- Quantify savings of water in years there has been excess rainfall

- Alleviate drought by negotiation
- Collaboration and cooperation between various stakeholders
- Develop a plan of operation which includes a weekly inventory
- Employ state of the art technology
- Writing books/videos
- Use media to spread knowledge and information about water
- Construct a model
- Establish an umbrella organizations and forums which act on both local and federal levels
- Prioritize water needs
- Observe, note and control malpractices
- General persuasion and legislation
- Implementation of best management practices

Barriers:

- Litigation about legislation
- Information about water not reaching a lot of people
- Minute and narrow minded protests

Ideal Future:

- Additional storage capacity being built
- A sophisticated distribution system
- Multiuse facility for public use
- Meet the needs of society without any conflict

Metrics:

- Observe indicators such as population change, trade balances, and GNP of the country

Paul Fesko

Interview by Zac Simpson and Charlie Stern
City of Calgary Offices, Alberta
January 12, 2007

Paul Fesko is a professional engineer and head of water resource planning for the City of Calgary. He is involved with the management and treatment of Calgary's water and wastewater. He monitors water quality levels on the Bow River, which runs through the center of the city. As an employee of the City of Calgary, Mr. Fesko focused on how Calgary could manage water more efficiently. He would like to see the city become a "non-consumptive" user of the Bow River, where the city treats and returns all of the water back into the river. He also imagines an effective storm-water strategy that would capture and treat runoff. He recommends recycling water and injecting it into aquifers for storage. Mr. Fesko reports major quantity and quality problems that need to be dealt

with in the river basin. One major water supply issue is that there just is not enough surface water to meet all demands. One significant water quality problem is that non-point sources impact quality, such as runoff collecting nutrients and loading the water course.

Mr. Fesko states that the increased population is a primary cause of stress on the basin but also cites land use changes that have placed stress on the resource. Another cause of problems for the basin is that the city lacks jurisdictional authority over water quality outside of city boundaries. Lack of jurisdiction limits the city from being able to monitor nutrient loading in areas that are close enough to significantly affect the city's water supply. If nothing is done to address these issues, Mr. Fesko states that there will be major growth restrictions placed on the city. He also believes that water rationing will be a likely occurrence. In order to address the current and future problems, Mr. Fesko believes that the city needs to continue to research and develop waste-water and storm-water treatment techniques. He argues that maintaining a proactive stance on water issues will promote prevention of problems rather than trying to escape from them. Mr. Fesko thinks that educational tools could affect per-capita consumption of water by changing the attitudes of users in Calgary.

According to Mr. Fesko, there are a number of barriers that could affect adversely the implementation of proper management strategies. Two barriers involve knowledge gaps in how climate change affects the basin and how groundwater and surface water interact. Another important barrier is the financial restrictions placed on research to close knowledge gaps. There are a number of resources that Mr. Fesko believes could be used as aids in better managing the river basin. He cited the current Water for Life program that promotes holistic management of the entire basin. He also mentioned the watershed stewardship groups that could be utilized in some planning processes. Mr. Fesko recommends that the monitoring of individual water users and reporting usage levels. He would like to see conventional water quality testing that identifies nutrient levels.

Problems:

- Water supply issues mean that there is no longer as much to go around
- Non-point source impacts and pollutants on the rise

Causes:

- Per capita consumption changes have led to increased water use over the years
- Land use changes, including logging, degradate quality for recreational purposes

Consequences of No Action:

- Significant limits to growth and zoning in the metropolitan area as water supply runs short
- Water rationing

Potential Actions:

- Continue to research and develop new waste water and storm water treatment technologies

- City council needs to continue to maintain a proactive stance on addressing water usage in the basin
- Increased education for conservation Ideal Future to change city users' attitudes. If people understand more about conservation, they may implement those Ideal Future in their daily lives, which will benefit the basin
- Implement demand-side water management strategies

Barriers:

- City lacks jurisdictional authority over water quality outside its boundaries
- Financial resources are not sufficient to fund adequate research concerning the capacity of the basin; individual groups need more funding along with educational programs
- There is a knowledge gap concerning the effects that climate change will have on precipitation patterns; this lack of knowledge leads to not being able to address a potential problem right now
- There is not an adequate understanding of groundwater in the river basin area; without such knowledge, it is hard to understand how surface and subsurface water interact in the basin

Aids:

- Water for Life Strategy and other holistic schemes that incorporate a broader view of basin management
- Bow River Basin Council and other similar watershed stewardship groups when utilized properly by the public
- Calgary's involvement in watershed management activities outside of the city

Ideal Future:

- City treats and returns almost all of the water that it takes in from the River and becomes a "non-consumptive" user
- Implement a storm water strategy for dealing with runoff and non-point sources
- Full tertiary treatment of all water used by the city so as to improve water quality levels

Metrics:

- Evaluate individual water metering system for residential users
- Monitoring to measure phosphorus, nitrogen, and dissolved oxygen

Lorne Fitch

Interviewed by Nishesh Mehta and Elizabeth Ojeh
Lethbridge, Alberta
January 9, 2007

Lorne Fitch, who worked for 35 years in Alberta as a wildlife biologist, now focuses most of his work on riparian habitats. He has always been professionally interested in water; his main professional interests include fisheries, wetland development, and habitat inventories. Over the past few decades he has observed significant increases in

population, agricultural, and industrial activities that strain the water supply availability in the region.

Mr. Fitch stated that irrigated agriculture uses about 70 percent of the water allocated from the river basin. In the past, industrial activities like coal extraction in the headwaters of the river system had threatened the region. Coal extraction has now been replaced by other activities such as oil and bitumen extraction, which also consume significant quantities of water.

According to Mr. Fitch, most of the rivers in the South Saskatchewan are over-stressed, especially the St. Mary's River, which has 108 percent of its water already allocated. The stress on the rivers is evident in declining flows in the rivers and/or the change in timing of river deliveries. The increase in demand, especially along the Edmonton and Calgary corridor, creates stress on the river system. If nothing is done to ease the pressure on the water resources, scarcity, competition and conflict over the water resources will ensue. Mr. Fitch cited government inaction and unwillingness to intervene with legislation to protect the environment as a hindrance to achieving proper management. He blamed the government's attitude on the influence of the strong irrigation lobby group.

Mr. Fitch stated that if ecological literacy is cultivated in the community the situation may improve. Learning the limits and threshold of the water resources is necessary for understanding the river system and how to manage it. He suggested that communication and education of all stakeholders might result in making better choices, such as deciding to cultivate higher yield crops that need less water to grow, instead of a crop like alfalfa which is widely grown and requires a lot of water.

For Mr. Fitch an ideal situation would be a healthy functioning river which is able to support aquatic life and riparian habitats. He believes that can be achieved by stopping any additional river allocations and assessing the prevailing situation in the river using biological indicators of river health such as the presence, diversity and population of aquatic invertebrates; presence and population of the local fish species; the diversity and health of the riparian habitat trees, such as cottonwood and willow species; and changes in the landscape over time. The indicator organisms have varying tolerances to changes in their environments, so it is important that more sensitive organisms are selected as indicators, otherwise a habitat may be lost or nearly so before harm is detected. Physical indices like the level of dissolved oxygen and temperature may also be used.

So far, several educational programs and initiatives have been implemented to increase the awareness of the community, such as the Yellow Fish Program, Water for Life, and various school curriculum programs. These will only be successful if they are continuous. However, for any of the programs to have lasting effect, attitudinal and behavioral shifts must occur. Most people are simply unwilling to change, especially if they are beneficiaries of the status quo.

To determine changes in the quantity and quality of the rivers, Mr. Fitch suggests that benchmarks be set and future trends measured against it. He said that there are already several benchmarks for measuring water quantity, especially in the larger rivers in the

basin/watershed, but smaller basins are not as well monitored as the larger ones. Water quality benchmarks are measured sporadically and inconsistently, thus making it difficult to track trends.

Problems:

- Change in the timing of water availability (seasonal variation)
- Decline in the river flow
- Water shortage
- Conflict over water distribution with many new interests coming up
- Danger to the ecological system sustained by the rivers
- Wasteful or inefficient use of water
- Ignorance and denial of users in accepting water as a scarce commodity

Causes:

- Urban development
- Oil and gas industry
- Population growth
- Over-regulation and allocation of St. Mary's River which has 108 percent of its water allocated
- Policy and planning vacuum
- 75-80 percent of the St. Mary's river water has been allocated to irrigation
- Growing of water intensive crops like barley, alfalfa
- Educational initiatives not long or persistent enough to affect attitudinal and behavioral changes in water users

Consequences of No Action:

- More scarcity
- Increasing competition on scarce resources
- Habitat and ecological losses
- Decline in the quality of life

Potential Actions:

- Engage in dialogue with all stakeholders
- Building of droughts and floods into the model and regulation of the rivers
- Cultivation of high value/low water crops
- Overcome inertia
- Set up benchmarks and scales to measure and construct a seamless trend line to gage the effects on water quality and water quantity
- A system needs to be established to monitor the smaller sub-basins to measure changes
- Do not allocate any more water
- Offer incentives to farmers who switch to less water-intensive crops
- Store water in natural silos, such as national parks or forest reserves, which are inviolate
- Checking the health of the area which acts as a natural reservoir for water in the South Saskatchewan river basin

Barriers:

- Entrenched interests, such as the irrigation industry
- Denial of climate change and the fact that water is a scarce resource whose use needs to be planned
- Misconception that technology will save the day
- Inertia against change

Aids:

- "Cows and Fish" program educating users on the importance of conservation of landscape
- "Water for Life" initiative by the government
- Educative programs initiated by Ducks Unlimited
- "Oldman Watershed Council" which helps spreading awareness and information about efficient and best usage of water

Ideal Future:

- A environmentally aware community that makes informed decisions keeping the environment a priority
- Healthy, functioning river

Metrics:

- Consider the in-stream flow needs for rivers to perform crucial ecological tasks
- Measuring water quality by using parameters such as dissolved oxygen, temperature, etc.
- Measuring aquatic life diversity and abundance, especially certain endangered species in the river or species that are sensitive to changes in the habitat to estimate the progress
- Fish presence and abundance
- Riparian vegetation (plants that like to keep their feet wet)
- Observe trends in the changes in the landscape and the scale of these changes using aerial photography, etc.
- Surveys to ascertain the attitudinal shift in people which eventually stimulates behavioral changes

Keith Francis

Interviewed by Emily Sentilles and Hilary Aten
Taber Irrigation District Office, Taber, Alberta
January 10, 2007

Mr. Frances is the Chairman of the Board of the Taber Irrigation District in Alberta, Canada. He grew up on an irrigated farm and currently grows feed (mostly alfalfa and some grains) and runs a cow/calf operation. Mr. Francis reports that the Taber Irrigation District supplies water to communities for irrigation purposes and to industry. About 85 percent of the water goes toward irrigation. Mr. Frances is thankful for the vision of pioneers that led them to turn the semi-arid region into a garden to feed the hungry of the

world. He believes irrigation has been a great blessing and is thankful to the Alberta government for developing the irrigation system. He states that the Taber irrigation district and most of prairie Alberta is semi-desert climate that receive only 10-12 inches of water per year. The increased need for water because of population growth contributes to the strain on the system. Mr. Frances cites global warming as a cause for anxiety about the future of the water in the rivers.

Mr. Frances' ideal for the future of the basin (and specifically for the Taber Irrigation District) is to have a secure water supply. He also wants to maintain the principle of "first in time, first in right." He would like all users to work together to allocate water to meet everyone's needs.

Some of the current problems in the Taber Irrigation District include growth of algae and other plants that clog the system during warm times as well as no assurance of a water supply for the future (as the rivers are fully allocated already). He also cites conflicts between the irrigation district and other users of the water and environmentalists who feel that users are diverting too much water from the river.

Some actions that Mr. Frances says would help the current problems include lobbying the government and water users working together for rationing as the needs arise. He cites the drought of 2001, the Taber Irrigation District self-imposed water use limits to maintain the water supply to towns and industries in the area. There is a general sense that the whole community needs to and can work together to resolve problems about water quantity and access. He would also recommend increasing the storage capacity of the tributaries to the Taber District. As per the tri-province agreement, Alberta is required to pass 50 percent of the water in the rivers on to Saskatchewan; at this point, Alberta is passing about 75 percent of the water on to the next province. Mr. Frances recommends a storage plan so that Alberta could use the water it is allocated more effectively and still store water for periods of water shortage. In addition to storage, Mr. Frances recommends that the farmers continue to take advantage of technology and its contributions to increase efficiency; he credits man's ingenuity for moving from gravity and flood irrigation to low-pressure pivots.

Some aids to future management of the river basin include already existing programs for river quality and quantity, such as the Oldman River Water Quality Initiative, a system that already monitors the river quality in Southern Alberta. The Water for Life program of the Alberta government is helping to educate the population about water conservation. The Water for Life Program has established watershed councils to discuss water quality, quantity and future needs concerns of stakeholders. These are all helpful programs in meeting the needs of everyone.

Barriers to better management of the basin would be lessened if the government reduced licenses on irrigation. Mr. Frances believes this would result in changed crop patterns and the inability of farmers to farm as they do now. Mr. Frances worries that global warming could reduce water supply below the volumes sufficient to take care of the present or future needs of water users. He believes this would lead to pressure on

irrigation districts to change their usage, which would impact the economic well-being and/or feasibility of farming.

Mr. Frances proposes that metrics for changes in the Taber Irrigation District would mostly revolve around more efficient ways for using water.

Problems:

- Water is fully allocated
- Dependent on water in irrigation district for crop growth
- Growth of weeds in warm weather clogs the irrigation system
- Conflict because environmentalists believe that irrigators are diverting too much water from the river system.
- Water shortages in drought

Causes:

- Population growth
- Climate change "if it is a reality, and it seems to be"
- Live in semi-desert climate with 10-12 inches of rain per year
- Dependent on crop growth for economy

Potential Actions:

- Increased storage capacity to retain 50 percent allocation of the river waters (per the tri-province agreement); currently Alberta sends 75 percent of flow to Saskatchewan
- Technology to continue to increase efficiency
- Government should do what is needed to decrease levels of carbon to control warming effects
- To take a hard look at how the region allocates water

Consequences of No Action:

- His worst-case scenario is that global warming reduces water supplies, so there is an insufficient supply to meet present demands or future needs
- There will be pressure on the irrigation district to change which will affect the economic status of farmers
- Reduced licenses would lead to change of crop patterns and farmers inability to continue farming

Aids:

- Three Prairie Province agreement for water distribution that establishes in stream flow needs
- Government for establishing irrigation system
- "Water for Life" strategy—the creation of watershed councils to monitor and discuss quantity, quality, and future needs

Barriers:

- Government could reduce licenses on irrigation districts

Metrics:

- Water efficiency metrics

Ideal Future:

- Assurance that there will always be a water supply
- Want to keep withdrawal priority rules as 'first in time, first in right'
- Increased storage capacity
- Work together to allocate water to meet everyone's needs
- Increase storage to maintain Alberta's river share (50 percent of water) in order to meet current and future needs
-

Harley Frank

Interviewed by Marco Campos and David Eaton
Blood Tribe First Nation
January 10, 2007

Harley Frank is a member of the Blood Tribe First Nation in southern Alberta. Mr. Frank is active in his First Nation tribe and was elected as Chief in Council in December 2004 as well as appointed to the Blood Tribe's Economic Development Committee. This Committee oversees agriculture projects on the reserve, including irrigated land, dry land, small business, oil and gas, and land management. Mr. Frank's original homestead was by the St. Mary's River. His grandfather was a successful farmer. Growing up in the Blood Tribe, Mr. Frank used the river for various farming and household purposes, as well as for trapping, swimming, skating, fishing, and sweat lodge ceremonies. Mr. Frank acknowledges that this experience with water and these types of memories may not exist in the younger generation of tribe members. Mr. Frank believes his professional involvement in water issues was a path determined by the creator; he accepts the responsibility but never sought service on the Development Committee.

The Blood Tribe reservation occupies approximately 540 square miles and is served by the Belly River and the St. Mary's River. Tribal membership stands at about 10,000 people. The reservation currently contains 350,000 acres of prime agricultural land. Mr. Frank notes that he has witnessed a change in the reservation landscape. From 1970 to 1975, 70,000 acres of virgin land was broken up for farming. At the time, there were no management practices and the tribe has since witnessed soil erosion and the loss of natural habitats.

Mr. Frank attributes several phenomena he has witnessed to global warming. In particular, poplar trees have vanished because the rivers no longer flood, geese do not take their normal flight south, the burrowing owl is now endangered, wetlands have disappeared, and sweet grass that is used for traditional ceremonies is harder to find. Pollution has affected the reservation's water. Whereas water was once fetched directly from the river, it is now trucked to homes. Tribe members now drink bottled water because the rivers contain contaminants, such as agricultural runoff originating upstream. Mr. Frank describes the quality of water as hard, full of minerals, and not adequate for most household purposes.

In the past 15 years, the Blood tribe has begun to manage its own water due to the recognition that agribusiness farmers were using water without appreciation for its value. Mr. Frank argues that planning is needed to ensure water for the future. Water sources need to be identified and environmental impacts need to be studied to ensure that water sources are sustainable. The Blood Tribe is open to cooperation with Alberta and local governments, though they feel as though they have been left out of planning discussions. This has led to policies adopted by Alberta Environment that have frustrated the Blood Tribe. Mr. Frank would like to see discussions take place among parties in the Blood Tribe manner: through honest and open dialogue, with a focus on the spiritual value of water.

Problems:

- Rivers do not flood or freeze
- Disappearance of natural habitats
- Endangered or extinct plant and animal species
- Change in migratory patterns
- Poor water quality
- Limited use of water for agricultural purposes
- Recreational use of river no longer possible
- People now use bottled water, or trucking of water, as opposed to potable river water
- Fish in river not edible

Causes:

- Global warming
- Rigid government regulations and policies
- Pesticides

Consequences of No Action:

- Rivers projected to dry up in 50 years

Potential Actions:

- Revise government regulations to invite more citizen advice
- Open dialogue and consultation with all stakeholders
- Identify sources of water
- Study environmental impact to ensure water source sustainability
- Focus on spiritual value of water
- Develop water policy based on sharing rather than regulation

Barriers:

- Bureaucratic control of natural resources
- First Nations rarely consulted, or consulted at the last moment
- Distrust due to violation of agreements
- License requirements that force First Nation to concede dominion of natural resources

Aids:

- Consultation process in 2005-2006
- Treaties

Ideal Future:

- Water meetings would start with a prayer and sharing of pipe to guarantee integrity and loyalty to one's word
- Adoption of a philosophy that speaks to the sacredness of water as a resource

Metrics:

- Water clarity
- A set of "natural" performance measures: the number of poplar trees; whether the river freezes; whether the grayling fish is extinct; change in duck or geese migratory patterns; and whether muskrat or beaver build mounds

Floyd George

Interviewed by Emily Sentilles and Hilary Aten
Eastern Irrigation District Office, Alberta, Canada
January 12, 2007

Floyd George owns a farm and ranch in Gem, Alberta. He serves on the Eastern Irrigation District Board in addition to other boards, including the local municipal council, school board, and hospital board. The Eastern Irrigation District has the license for the most water withdrawals on the Bow River, and, Mr. George believes, stands to lose the most from management problems in the basin.

Mr. George would like to see the Eastern Irrigation District build a reservoir or freeze the glacier again in order to maintain water flows. He would like to see changes and decisions to offset the environmental impact of climate change. Additionally he would like to see individuals and/or groups ascertain the rights to convey water and charge for the conveyance, rather than have this right monopolized by the irrigation district.

Current problems in the Eastern Irrigation District include droughts, the inability to capture water for times of shortage, water quality issues, and conflicts regarding how the water is allocated. The water supply, according to Mr. George, is in jeopardy. The district, he says, needs the ability to capture water for times of water shortages. The conflicts regarding allocation are mostly with regard to conveyance versus access rights. There are disagreements because the District asserts it has all the rights; the licenses are held for the farmers, and Mr. George would like the farmers to have the ability to charge for conveyance. With regard to quality, there have been some issues in the past, but currently there are enough flows to dilute pollutants in the river.

According to Mr. George, the main cause of these problems is the growth of Calgary, including the growth of industry, cattle operations, and the one million people living upstream. The second contributor to these problems is the glacier melting caused by climate change.

Mr. George recommends that the government negotiate plans for the future in order to eliminate risk of shortages in the future and "stay on top" of water quality. He would like to see realistic planning that weighs the ramifications of storage against the benefits it could provide. He believes that stakeholders and the government should use other international examples to help their planning process. He thinks that the public awareness that water is not in endless supply is a benefit to the planning process. He credits the government's Water for Life program for creating better public awareness. He also says efficiency in the water system is helpful for better management, though they can continue to become more mechanized.

There are questions about where to build a reservoir. Environmental concerns could hinder and slow the process. Mr. George is willing to consider dams and reservoirs to enhance supply, as he is convinced that if nothing is done, there will be disagreements over an even scarcer supply of water, although there are question about where to build a reservoir and the potential of changes to ecological systems. Mr. George suggests testing water quality and quantifying "enough growth and enough industry."

Problems:

- Drought—water supply in jeopardy
- Users are unable to capture water for storage
- Conflicts about how water is allocated, who uses it and why
- Conflicts about conveyance versus access
- Quantity—whether there is enough water to dilute pollutants
- Glaciers melting
- Water quality issues

Causes:

- Calgary is growing
- Industry, cattle operations, and 1 million people upstream

Actions:

- Plan for the future to reduce the risk of shortages
- Assess the ramifications of storage
- Building dams to create reservoirs to provide one-year storage

No Action:

- More disagreements over scarcer supply

Aids:

- Work with other municipalities to improve planning
- Public awareness that there is not an endless supply of water
- Government efforts to refine goals (i.e., Water for Life)
- Engineers to enhance the efficiency in system and water usage

Barriers:

- Dams change in-stream ecology
- Reservoir location
- Impacts and environmental concerns

Metrics:

- Water quality criteria
- Measurement of water sufficiency for drought periods (5-7 year storage)
- Growth
- Metrics to evaluate the adequacy of industry

Ideal Future:

- Assured water supply, either through a reservoir or stabilizing glacier
- Make changes or decisions to offset impact of problems
- Allow individuals the right to convey water and charge for it, rather than just a water district

Gerhardt Hartman

Interviewed by Nishesh Mehta and Elizabeth Ojeh
Lethbridge, Alberta
January 9, 2007

Gerhardt Hartman has been retired for about 10 years from his irrigation district management work but he is still involved in the Oldman Watershed Council. He has lived and worked in Southern Alberta since 1961. As far as he can remember, he has always been interested in and involved with water, and has worked for most of his years with irrigators. He supports conservation and believes in living his convictions and leading by example. His house, which was completed in 2001, is constructed to maximize energy savings, with 9-inch thick polystyrene filled walls that received a rating of 35 points on a conservation scale (above the 6-inch thick standard walls that are rated 20 points). This provides very good insulation, hence air conditioners are not required even in summer. His bathrooms are fitted with a dual flush system to allow 3 or 6 liter flushes as needed. In the winter, the house is warmed by a system of plastic pipes that run underneath 1.5 inch thick concrete floor. The hot water heater is fitted with a small pump to get the water to the point of need in as little as three seconds to eliminate waste that occurs when the water is left to run until the hot water arrives.

Mr. Hartman hopes for a future in which society is more aware of its responsibility in managing the resources that sustains it. He would like to see a higher level of treatment of sewage before it is returned to the river. He argues that some legislation to require, or incentives to encourage, homeowners and residents to implement conservation practices at home. The government has in recent years become more responsive in funding water initiatives like the Water for Life initiative, but political will is required to keep these activities going. Support and funding received from volunteers, public companies, consulting firms, and the society has been helpful also.

Mr. Hartman has seen major changes to the natural regime of the rivers over the last half century due to diversions and reservoir constructions. These changes, though beneficial to man, need to be managed carefully. Hence, the Integrated Water Management Plan, which is under development for the Oldman Watershed, is an important step in attaining

a sustainable system. He has also observed tremendous change in the way the agricultural sector uses water: they are now consciously implementing efficient irrigation systems. Farmers along river banks and close to riparian habitats now build fences to prevent their livestock from directly accessing the rivers to drink, thereby reducing the amount of manure that gets into the river. Mr. Hartman suggests that this practice has produced a direct benefit of a 30 percent increase in birth rates of cattle and a significant reduction in cattle disease.

Mr. Hartman believes the timing of the withdrawals from streams should be monitored to improve downstream conditions. Using the river resources with the sole aim of making economic gain is detrimental to the environment and to the economy in the long run. He hopes that more people will become educated and change their perception of natural resources. He is afraid that if concerted efforts are not made, and the rivers left without proper management, the environment will deteriorate fast, especially the smaller tributaries which suffer more from water quality issues.

Gerhardt Hartman hopes he can in a little way influence his community so they can understand that everyday activities, like driving, camping, and yachting, if not done responsibly, can be detrimental to the environment, especially in a semi-arid climate where water quantity variations are common.

Problems:

- Change in the flow of the regime in the river
- Water quality problems in smaller tributaries

Causes:

- Difference in economic interests of various stakeholders

Actions:

- Comprehensive and integrated water development plans need to be developed in tandem with everyone around the table
- Open forums and meeting of all stakeholders
- Seeking consensus on crucial issues and decisions regarding water
- Re-planning of water with special emphasis on its distribution
- Volunteering time and in kind to support efforts to improve management plans for water in the river
- Efforts to change the attitude of residents
- Research and documentation of best management practices
- Endurance of political will committed towards water resources
- Election of the right people
- Water conservation practices
- Standards and benchmarks to assess water quality
- Changes in the license awarding policy
- Monitoring and adherence to plan

No Actions:

- Gradual degradation of water quality in the Oldman River

Aids:

- Integrated water development plan
- "Water for Life" initiative by the Government
- Planning by the Provincial Government

Barriers:

- Wrong attitude of people solely interested in economic benefit
- Less understanding and education of farmers
- Interests of the oil and gas industry
- Retaining political will

Metrics:

- Measurement of water flow
- Estimate the salinity of water

Ideals:

- A well thought out, integrated water management plan which addresses all stakeholders and demands
- Attitudinal change in residents and water users at large

Alice Hontela

Interview by Emily Sentilles and Hilary Aten
Department of Biological Sciences, University of Lethbridge, Lethbridge, Alberta
January 10, 2007

Alice Hontela, Ph.D., began her career at the University of Quebec at Montreal, coming to the University of Lethbridge (UL) three years ago to conduct research in physiology and ecotoxicology, in particular the impacts of chemical and pharmaceutical pollution from agriculture on fish. She is currently teaching at UL and conducting research on endocrine disruptors in fish in the South Saskatchewan Basin.

Although the basin can never return to a perfect river system, due to the multiple uses of the basin, she does hope that collaboration and open-minded attitudes can result in a future in which scientific information is gathered and reviewed for the basin. She hopes that this future would include technological progress, such as self-contained industries that release only safe, high quality water, and agricultural operations that draw less water overall, reducing impairment to the river ecosystem. Dr. Hontela states that she has seen changes in the ecosystem making the river more vulnerable, due in part to the water diverted from the river for irrigation. In addition, she has seen fish species, including the whitefish, affected by pesticides and increases in water temperature from climate change. She has found evidence of pharmaceutical and hormone contaminants in the Oldman due largely to human use and runoff from feedlot operations. All of these problems are complicated by knowledge gaps about exposure levels in the basin, as well as limited funding and staffing for monitoring programs at Alberta Environment.

Dr. Hontela fears that if no action is taken to address these problems, the South Saskatchewan Basin could either run out of water or have a small amount remaining that is too contaminated for use. In addition, she fears that climate change could cause the glaciers to disappear, losing the source water for the basin and drying up the rivers. She recommends several educational and research strategies be adopted to avoid this future, including intensive monitoring of river water for chemistry, bio-chemistry, and physiology studies to assess the health of the fish populations. She also recommends that multi-disciplinary collaboration among experts in relevant fields be used in decision making, including representatives from the government, private, and academic sectors. She advocates for responsible use of chemicals and technology in construction and development to avoid further degradation.

Dr. Hontela sees possible barriers to accomplishing these actions in the difficulty of maintaining accuracy in monitoring, as well as the time commitment required to collect and assess data to keep pace with rates of growth. Dr. Hontela perceives as potential obstacles the public attitudes of protecting the industrial economy and competing objectives in environmental issues. She sees advances in technology and possible budget increases for Alberta Environment as aids towards accomplishing the necessary actions. She is optimistic about the role that continuing research, including current graduate student research, can play in planning for a sustainable future for the South Saskatchewan River Basin.

Problems:

- Species at risk (whitefish in particular)
- Knowledge gaps about exposure levels in Alberta
- Chemical and pharmaceutical contamination in waterways
- Increased water temperatures
- Changing structure of ecosystem makes system vulnerable

Causes:

- Type of agriculture in area relies on heavy pesticide use and irrigation
- Drugs and hormones used in feedlot livestock
- Climate change
- Limited funds and monitoring capacity in Alberta Environment agency

Consequences of No Action:

- Run out of water
- Little water left may become so contaminated it could be unusable
- Glaciers/source water disappears, rivers dry up

Potential Actions:

- Intensive monitoring
- Well-designed chemical, biological, and physiological studies to identify most sensitive indicator species
- Multi-disciplinary collaboration in research, discussions
- Education of all sectors (public, government, private)
- Construction to prevent pollution

- Use chemicals responsibly with development

Barriers:

- Monitoring can be inaccurate depending on timing
- Stakeholders have competing objectives in environmental problems
- Time commitment to research and collect accurate and clear data
- Quick pace of growth and development of complexity in problems
- Public resistant to negative news on industry that provides economy

Aids:

- New technology to detect pharmaceuticals in water
- Alberta Environment's budget
- Still time left to fix problems
- Universities, academic institutions

Ideal Future:

- Multiple uses of this basin means we'll never return to a perfect, healthy system
- Collaboration
- Critical and open-minded about information gathered from basin
- Self-contained industries that release only high-quality effluent
- Water carefully withdrawn for agriculture to preserve integrity of rivers

Metrics:

- Safe and acceptable levels of chemicals in water, with quality well within safe limits
- Withdrawal limited to prevent river impairment
- Decrease in use and consumption

Ted Horbulyk

Interview by Zac Simpson and Charlie Stern
University of Calgary, Calgary, Alberta
January 8, 2007

Ted Horbulyk is an environmental economist at the University of Calgary who has concentrated on issues related to public choice and agriculture/environment for over 20 years. A few years after being hired, Dr. Horbulyk began researching water-related issues in coordination with local authorities. Dr. Horbulyk would like to see a water-pricing system in which all relative values for the resource are taken into account. Currently, there is no system in place that assigns values to various use methods such as agricultural irrigation, industrial processes, and potable residential usage. His ideal management system would incorporate flexible management and resilience, which will adequately address shocks to the system such as periods of drought and flood. Dr. Horbulyk refrained from citing any overarching problems. Instead, he mentioned the potential of future problems associated with the occurrence specific events. He cited concerns with new compounds affecting the quality of water such as endocrine disruptors, phosphorus, nitrogen, chlorides, and dissolved oxygen.

Dr. Horbulyk attributed changes in the water basin to increased population growth, which places stress on the availability of surface water. In addition, Dr. Horbulyk believes that climate change will have measurable effects on the South Saskatchewan River Basin. If these issues are not properly addressed, he sees the potential for more cataclysmic events with intensified negative shocks to the surface water delivery system in the region. Various ecosystems along the basin would experience degradation as health of important species decreased. Dr. Horbulyk states that these circumstances would require a rigid rule-making system to be implemented, which would be less efficient than a proactive policy instituted in the present. Instead of waiting for these unfortunate events to occur, Dr. Horbulyk would like to see principles of management established. While certain barriers such as jurisdictional clarity and public knowledge exist, he believes that there are resources such as financial and educational support that can aid in the implementation of these principles. Dr. Horbulyk suggested that decision-makers look at similar situations where other governments successfully allocated water rights to maintain the sustainable integrity of the surface water resource.

Problems:

- Receding glaciers in the headwater areas
- New compounds effecting water quality
- Potential for more problems in the future associated with drought

Causes:

- Increased population growth in the South Saskatchewan River Basin continues to place stress on the resource
- Climate change affects water via precipitation and potential evapotranspiration
- No longer seepage into groundwater from irrigation canals as more of them become sealed or lined

Actions:

- Centralized principals of management of the surface water system
- Education on how property rights could change with new market system

No Action:

- Negative effects on the ecosystem, such as reductions to trout fishing, as health of species in the river declines
- Downstream populations would be adversely affected by poor quality upstream
- A rigid rule-making system would develop and not be as effective as a system that was implemented prior to a crisis
- Reliance on rationing could be a reality
- More cataclysmic events will occur, such as the drought of 2001-2002

Aids:

- Citizen's participation movements
- Increased data monitoring for both water quantity and water quality measurements
- Support networks and watershed groups (including financial support networks)
- Consult First Nations for historical knowledge relating to water management

Barriers:

- Lack of clarity with respect to jurisdictional areas and authority on water rights
- Lack of public knowledge concerning proper conservation techniques and water management skills
- Insufficient knowledge of the role that groundwater plays in the Saskatchewan River Basin

Metrics:

- Capture the value to society that a specific water quantity provides
- Assign different values to agriculture crops that result in increase in comparison cities and observe income
- Consider looking at growth management strategies and how they affect per-capita demand for water in urban settings

Ideals:

- Researchers assign a monetary value to water that accounts for relative values across uses (including across time and location of uses)
- Build a system that incorporates resilience and considers more than yearly average flows

Brian Ilnicki

Interview by Brandon Steinmann and Alicia Williams
Ducks Unlimited Alberta Headquarters, Alberta, Canada
January 11, 2007

Brian Ilnicki is the Head of the Industry and Government Relations for Ducks Unlimited in Edmonton, Alberta, Canada. Ducks Unlimited states that for more than 65 years, it has been committed to wetland conservation in Canada and describes wetland preservation as its number one priority. Ducks Unlimited works with the landowners, conservationists, and the government to find solutions to Canada's water problems through its role as a national, private, non-profit organization.

Mr. Ilnicki identified the lack of water availability from the river basins as the major problem facing Albertans. The lack of restrictions on water use in this fast-growing, economically burgeoning region has intensified this problem. Industrial development, massive urban expansion, climate change, and increased oil and gas exploration in the river basin's surrounding areas have caused water availability to be stretched to its limits. The inability of the region to enact a comprehensive water management plan has prevented government entities from better regulating water usage. Without action, the courts will be forced to take an increased role in determining water rights as industrial users seeking to become more profitable continue to fight for more water resources. Mr. Ilnicki argues that all levels of government must get involved and help manage the water availability problem by developing guiding principles whereby water can be managed at the basin and sub-basin level. In addition, the watershed base planning initiatives, such as Water for Life, must be fully funded and supported.

The barriers to action in solving the water crisis cited by Mr. Ilnicki include a lack of education, the lack of involvement by water stakeholders, the expense of creating new technologies that could aid in making water use more efficient, and the reality that change is necessary to protect current water levels. By addressing each of these barriers, a provincial water strategy can be crafted that has broad acceptance by all water use stakeholders. If people think about water on a true watershed scale, then its limits, importance, and viability can be fully understood and appreciated. Mr. Ilnicki argues that for a true solution for water quantity to work, users must be more accountable, more responsible, help contribute resources to education and technological pursuits, and begin now to address problems. Only with a commitment of resources, funding, and volunteers, can new plans for watershed management be drafted and implemented.

Problems:

- Limited amounts of water

Causes:

- Not enough restrictions on water use
- Increase in industrial development
- Expanded agriculture industry
- Urban expansion has caused infrastructure growth
- Increased oil and gas exploration
- Climate change (recent droughts)
- No comprehensive water management plan

Consequences of No Action:

- Conflict will increase with more litigious action in courts
- Industry will continue to want to use more water resources to increase their output

Potential Actions:

- Fully fund the watershed base planning initiative supported by the Canadian government and conservation groups—support the Water for Life Program
- Support at the basic levels of government will help to manage the problem
- All issues should be brought to the table for developing guiding principles whereby water can be managed at the basin and sub-basin level
- People need to think about water—all facets and types of water on a true watershed scale
- Determine what features of water and its use we want to enhance, protect, and restore
- Determine who should pay the costs
- Encourage users to take more responsible and accountable for their use
- All parties must realize that each water basin is different and that adequate resources must be allocated to help plan for the future
- With a commitment of resources, funding, and volunteers, new plans for watershed management can be drafted and implemented

- Comprehensive review of existing water resources. Where is the water? There is no current, comprehensive inventory of Alberta's water. Where is all of the surface water? Groundwater?

Barriers:

- Lack of education about water
- Lack of involvement by all stakeholders
- Change is hard to comprehend and accept
- New technology is too expensive

Ideal Future:

- Society as a whole should adopt goals for a provincial water strategy that has broad acceptance by industry, all levels of government, and the people
- Awareness of water
- Awareness of the limitations of water

Metrics:

- No net loss of water in the province—the quest for a net gain can be a future goal
- High water quality in place so that natural filtration can work and be enhanced
- Five-year review of water levels—to review, ensure, and judge water progress in quality and quantity

Dave Kiely

Interview by Brandon Steinmann and Alicia Williams
Agra-Food Canada, Edmonton, Alberta
January 10, 2007

Dave Kiely is the Manager of the Strategic Water Investment Unit at Agriculture and Agra-Food Agency in Edmonton, Alberta, Canada. He works primarily in the division of the PFRA (Prairie Farm Rehabilitation Administration). He delivers a national water program and works on policy issues that deal with water. Mr. Kiely believes that development in communities, increases in urbanization, and irrigation techniques are causes of over-allocation of water. In Mr. Kiely's opinion water management is crucial in alleviating this problem. He states that irrigation districts need to take action to manage their water use and its effect on the community. He also argues that more resources should be made available to create an open discussion about water usage, implementing a system of feedback for community members.

Problems:

- Lack of water
- Drought

Causes:

- Urban growth and development
- Increased agriculture uses
- Large differences among industry, government, and community water users

- Climate change

Consequences of No Actions:

- Increased urbanization and continuation of lack of planning
- Cities will fight over resources

Potential Actions:

- Decrease water licensing
- Metered water use
- Create more resources and incentives
- Subsidize system for water usage
- View the issue in a multi-discipline view

Barriers:

- Economic effects (more expensive for water users)
- If the price is not right, then it is not effective
- Government issues among provinces.
- Higher self-regulation
- Limit of licensing for irrigation practices

Aids:

- Watershed groups

Ideal Future:

- Meter use of water

Metrics:

- Provide minimum guidelines for water usage
- Always evaluating status of where you are; future thoughts on water usage

John Kolk

Interviewed by Nishesh Mehta and Elizabeth Ojeh
Lethbridge Northern Irrigation District, Lethbridge, Alberta
January 11, 2007

John Kolk is a county councilor born in Lethbridge who has lived there most of his life. He is a farmer and operates 19 quarters of irrigated land and 5 quarters of dry land. He first developed a professional interest in the rivers some 17 years ago due to an odor-related problem emanating from the river. This problem perturbed him because he is dependent on the river for much of his livelihood and he believes in stewardship and accountability for the resources that nature provides.

Mr. Kolk reported that human encroachment especially into the riparian habitats has severely affected water quality, causing significant water quality decline in the 1980s, with bubbles visible on the surface of the water. However, the river has been much cleaner in the last three years since the city improved its level of wastewater treatment.

Point source pollution is mostly under control with the aid of effluent standards; non-point pollution, like rainfall runoff, is still a problem. The poor quality of the rivers have became a point of contention between agriculturists and environmentalists, with the latter demanding a seat at the table where issues relating to water allocation and water management policies will be discussed.

Mr. Kolk recounts that during the 1990s, a gradual shift was made from conflict to cooperation, as understanding grew that the substantial investments made by irrigators over the past century ought to be protected while not neglecting the environment. With increase in population along with business and industrial activities, however, this might prove to be a difficult. The task is to increase the efficiency in water use and yet somehow find a market price for water without pricing local agricultural production out of the market. Mr. Kolk state that pricing the water will lead to less waste and increased efficiency, but the level of efficiency is dependent on the level of technology.

Mr. Kolk cited other drawbacks including inadequate funding of initiatives, political borders interfering with river basin management, and inadequate energy committed to addressing the issue of the environment. He opines that more effort should be devoted to attracting businesses that are less water-dependent, and that the community should commit to keeping the rivers clean. Other positive steps like xeriscaping, community engagement, and the Water for Life Strategy (which is focused on a basin approach to management) should be intensified. It is also important that water resource managers work with private landowners to improve water quality, especially those directly along or adjacent the river. This may involve paying for filters (underground or surface), that prevent easy access of runoff (bearing nutrients and bacteria) to the river, to be installed on private property, like the City of New York (installing filters at a cost of $1 billion, instead of building a water treatment plant, thereby saving $10 billion), if it is the most cost effective solution.

Mr. Kolk observes that some other problems arise with changes in processes, such as loss of some habitats, because more efficient application of water reduces runoff to marshes and wetlands. As municipal treated waste water ends up in the river, so does pharmaceutical residue and hormone (estrogen) altering wastes, the cumulative effects of which are still unknown. There is thus a need for a long-term commitment to research and monitoring of the environment to better understand the aquatic habitats and the species they support.

Mr. Kolk is hopeful that the current initiatives will continue and will be followed up as required, and that the oldest inhabitants, Aborigines, will be consulted for advice. His parting message was that the balance of the system must be seen as three legs of a triangle: social, environmental, and economic. A full cost accounting (inventory) must be made of the system in terms of the social and environmental assets, liabilities and cash flow, even if there are difficulties assessing those performance measures. He suggested that perhaps a program like the Peace Corps could be implemented so that young people can learn early to appreciate the resources that sustain them.

Problems:

- Conflict in allocation of water
- Food/agriculture loses water supply to recreation (golf courses)
- Political borders create conflict
- Deterioration of water quality (heavy nutrient levels)
- Water price for agriculture

Causes:

- Human encroachment of land
- Environmentalists do not have a place on the table
- No consistent strategy to determine how the water is to be used and who will decide
- High level of capital investment not paying off
- Increasing population
- Increase in industrial and business activities (oil and natural gas industry)
- People not cognizant of the needs of the land
- People from all walks of life not involved in spreading of water consciousness
- "First in time, first in right" policy

Consequences of No Action:

- Collapse of society if resources are not protected

Potential Actions:

- Ration water
- Farmers should tell people how and what they are doing with water
- Increasing efficiency of water use
- Participation of public in water cleansing
- Payment to environmental goods and services and people who provide it
- Orientation of governance needs to be water-centric
- Leadership to integrate economics and environment
- Attitudinal change in people
- Improve measurement of water quality along the river
- Better understanding of species
- Funding and commitment towards a regime for environmental goods and services being produced by focusing on the right locations
- Incentives to the producers of environmental goods and services
- Every kid in the age group of 10-20 should spend 1-2 months cleaning the river
- Measure river basin changes to devise efficient strategy
- Measure the change in water ethic, i.e., how to use water

Barriers:

- Under-funded initiatives
- Not all communities represented (like aboriginals)
- Insufficient knowledge about long term impacts of water use on the eco-system
- Not enough transparency

- Lack of comprehensive understanding of our social and environmental foot print in the eco-system
- Lack of resources to implement best management practices

Aids:

- City wastewater treatment plants
- Significant progress has been made in cleansing the river
- Xeriscaping
- Water for Life Initiative
- Basin communities

Ideal Future:

- Change in economic activity in the area
- Resolve how natural environment gets its water and make a community decision on its best use
- Focus on low water using industries
- Outgoing commitment from people towards water
- Keeping water clean

Metrics:

- Growing of a high value crop
- Full cost accounting by taking into account environmental assets, cash-flow, liabilities, social costs, and economic costs

Martha Kostuch

Interview by Brandon Steinmann and Alicia Williams
Rocky Mountain House, Alberta
January 12, 2007

Martha Kostuch describes herself as an environmental activist whose passion for Canada dates back to her immigration to Alberta 30 years ago from Minnesota. Ms. Kostuch moved to Canada because of her love for the mountains and wildlife that are plentiful in Alberta. She is active with the Friends of the Oldman River, which fought the creation of a dam in the late 1980s. She has been involved in taking cases to court on multiple occasions to stop conservation damage and damage to fisheries in the Red Deer River and South Saskatchewan River Basin.

Ms. Kostuch is concerned about the poor water quality in the South Saskatchewan Basin and the impact this is having on the area's environment. She explained there is an abundance of evidence demonstrating that Alberta's fisheries, wildlife, and aquatic ecosystems are being destroyed. Further, she fears the already fleeting availability of water will be further diminished by the growing needs of ranchers and farmers who want many of the north-bound rivers turned south to aid the agricultural industry and business interests in the United States. She identifies Alberta's urban expansion, which has contributed to the over-allocation of water resources, and the lack of metering by cities as

major causes of the region's lack of available water. She also believes that climate change is reducing the amount of water flowing into the South Saskatchewan River Basin. Water issues, according to Ms. Kostuch, continue to be dominated by money and the interests of the industrial and agricultural users. Water must be protected for all users not just the ones who have the most money to pay.

According to Ms. Kostuch, reducing allocations of water and enacting moratoriums on future usage is the first step to increasing the basin's availability of water. She also cites the importance of using the courts and political processes to help encourage public involvement with a Saskatchewan River protection campaign, as well reducing harmful greenhouse gasses that are exacerbating climate change. Ms. Kostuch argues strongly against the legal right to own water forever. She sees current water rights as a significant barrier to reform and believes that common-sense approaches must be instituted to protect water availability for everyone. Without public awareness, political pressure from agricultural and industrial groups cannot be thwarted and good water policies will not be implemented. Ideally, Ms. Kostuch hopes for the universal realization that water resources are critical and fleeting. With public awareness, she envisions more financial aid, better accountability, and more responsibility by water users. In addition, with this increased level of education and understanding, healthy ecosystems will be restored, pollution levels in the rivers and water basins will be significantly reduced, and water levels and their natural flow will be protected.

Problems:

- Poor water quality
- Lack of available water
- Fisheries, wildlife, and aquatic ecosystems are being harmed.
- Ranchers and farmers want to divert many north-bound rivers to the south to help agricultural interests and the United States to receive additional water

Causes:

- Over allocation of water—too little water to support the current usage levels
- Urban development
- Unmetered city water usage
- Lack of water storage capability
- Water is about money and profit for industry.
- Climate change continues to decrease the available flow of water

Potential Actions:

- Reduce allocations of water and spread moratoriums on future usage
- Reduce greenhouse gasses to help mitigate climate changes
- Use the courts and political process through hearings and public awareness campaigns to get the public involved
- Use the Fisheries Act, which is a federal law, to make charges against individuals and industries that are not using water responsibly
- Moratoriums on future water usage—will be necessary if allocations cannot be changed among current users

- Users should pay more for the water they use

Barriers:

- The legal right to own water licenses forever continues to be a major problem in curbing water usage; this law must be changed to allow water use possible
- Political pressures from industry groups must be countered because irrigation and industry representatives have a great deal of money and influence that they use to steer water
- Alberta's legislature is run by the rural farmer interests counter to the needs of the environment and the cities needs.

Ideal Future

- Ensure that water flows are natural and not diverted, which protects water
- Healthy ecosystems are restored and pollution levels in rivers and water basins are reduced
- Public awareness of water is universal
- All citizens to help aid in water accountability and responsibility
- Industry will play by the rules and work to protect the environment of Alberta

Metrics:

- A comprehensive review of flow needs is necessary to ensure we know the "who," "what, and "where" of water resources
- Aquatic ecosystems can be monitored to ensure that pollution and chemical levels are low and that aquatic wildlife numbers are increasing

Arlene Kwasniak

Interview by Zac Simpson and Charlie Stern
University of Calgary, Alberta
January 12, 2007

Arlene Kwasniak teaches law at the University of Calgary. Her primary interests are in water law and policy, which she has researched for the past 15 years. She has published research articles dealing with water scarcity in the South Saskatchewan River Basin.

Professor Kwasniak's ideal water management approach would be to promote watershed planning that would include the use of adequately funded Watershed Planning and Advisory Committees (W-PACs). She argues that assigning value to the resource could facilitate equitable distribution of water. Professor Kwasniak states that water quantity in the South Saskatchewan River Basin is an issue because the basin is currently over-allocated among stakeholders. As a result, the river is not meeting adequate in-stream flow levels. She states that an important cause of this problem is that current license holders have incentive to use the entire amount of their license, whether it is needed or not. She argues that the prior allocation of water rights has led to inefficient uses of the resource. As well, considerable power placed in the hands of irrigators. If nothing is done to address these issues, Professor Kwasniak is concerned that there will not be

enough flow in the water course, which will lead to poorer water quality and further adverse effects on fish populations. She sees the water resources as an important source of financial income for the province; if nothing is done to preserve the resource; she states that tourism could take a major hit.

To address the problems, Professor Kwasniak would like to promote privately held in-stream licensing using economics as a framework to replenish in-stream flows. She also thinks that a change is in order for the current structure of water licensing and would like to see cancellation of an entire license or portion of a license for non-use. This water transfer system would replenish in-stream flows, while promoting efficient use of the resource. Professor Kwasniak believes that there are a number of important barriers that will impede her recommended actions from being taken. The first barrier is that the restructuring of the licensing system would not be easy because existing license holders will not want to give up portions of their license. The second barrier concerns the widely-held idea that water left in the stream is "wasted" by not being used. Professor Kwasniak believes that there are currently some resources that could be incorporated into the water management system. She believes that existing research on climate change could be helpful in presenting the urgency of adequately managing the river basin. She cited baseline data that could be used as an educational tool to reinforce some important management topics. Professor Kwasniak listed some performance measures that could be monitored to determine if the river basin was being managed properly. She would like to see in-stream flows monitored and compared with reports that have determined what in-stream flow levels are required for the river basin ecosystem to be sustainable.

Problems:

- Water is currently over-allocated among license holders
- The most beneficial and efficient uses of water are not being pursued and encouraged under the current water management system
- In-stream flow levels are not currently being met to fulfill aquatic needs

Causes:

- Irrigators have become mini-water "corporations" that have monopoly over the resource throughout much of the area
- License holders currently have the incentive to use every bit of the water they own, thus over-use is encouraged by current management
- Prior allocation can give less efficient users first priority over newer, more efficient users

Consequences of No Action:

- There will be more fish impacts
- There won't be enough water in the water courses, which will lead to poor water quality
- Tourism will be reduced as all beautiful rivers have less flow, more quality problems, and can withstand less activity
- Water treatment will have to be done more and at a much high level of sophistication

- More junior license holders will be cut off

Potential Actions:

- Promote privately held in-stream licensing using economics to replenish in-stream flows
- Change the definition of what constitutes water diversion to include not only point source but non-point source transfers
- Cancellation of license for non-use
- Incorporate in-stream flow needs as part of the legislative schemes
- Revisit "first in time...first in right" allocation of water rights
- Recognize the difference between a license and a property right
- Change the structure of licensing to allow for cancellation of a license or portions of a license for non-use
- Water transfer policies should be designed to not allow transfer rights on a sleeper licenses

Barriers:

- Political barriers loom large, as people don't usually want to give up their pre-existing rights in this area and turn them over to the government
- Common resistance to any water that is left in streams, which is often perceived as "wasted" water

Aids:

- Baseline data currently in existence regarding in-stream flow needs
- Past and current research on climate change can be incorporated into current modeling

Ideal Future:

- Revisit wetlands policy
- Watershed Planning and Advisory Committees (W-PACs) given the resources that are needed to pursue clear goals
- More accountability displayed in the irrigation districts
- Consider pricing water (a fee for the water) and implementing a market-based trading system

Metrics:

- More water flowing in the system will be a good indicator of achieving goals
- Compare in-stream flows that are monitored in the basin to reports that show what in-stream flows need to be

Barbara Lacey

Interviewed by Nishesh Mehta and Elizabeth Ojeh
City Hall, Lethbridge, Alberta
January 11, 2007

Barbara Lacey was at the mayor's office and graciously consented to answer a few questions. Dr. Lacey is the Chairperson of the Oldman Water Council. She was a practicing public health physician for 30 years, which led to her involvement in water issues after the outbreak of gastrointestinal diseases in Lethbridge and surrounding areas. It was first suspected that as intensive livestock operation was responsible, but it was later traced to the poor water quality. Dr. Lacey states that later research found that the general water quality was not bad, but there were some points that really needed to be addressed.

Dr. Lacey recounted that there have since been efforts to balance the needs of the river and its ecology with that of the land and the people. This was all the more important as the snow packs and glaciers have been disappearing. A major concern was that most people perceived water as a renewable resource, so massive public enlightenment would be required. She indicated that research into the effects of contamination on ground water is required. Other sources of contamination identified include washing of cars on the streets and fertilizers from farms and lawns.

She says the management of water resources has previously been left to the government department which was having trouble attending to all the basins. Now with the creation of watershed councils, many more stakeholders are involved, and they have been able to better coordinate efforts towards river basins. Waste water treatment was made a priority, so Lethbridge was able to construct an award winning treatment plant. Higher effluent standards are now being required. Other issues that are up for debate include whether water is a commodity that can be bought and sold.

Dr. Lacey commended the efforts by farmers and landowners in riparian stretches. Dr. Lacey hopes the future will be much better with healthy riparian habitats and fish still in the rivers. She hopes for less lawn irrigation, low-flow toilets, a healthy irrigation industry (even if not as big), and a better controlled use of land in the headwaters. Political will from the provincial and local governments has been helpful and trust has been building among the stakeholders making it easier to work together.

Problems:

- Water quality
- No replacement of glaciers so water quantity will be a problem eventually

Causes:

- Intensive livestock activity
- Global warming

Potential Actions:

- Achieving balance between river ecology and water use by people
- Change people's outlook about water being a renewable resource
- Organize a meeting of stakeholders to decide priorities for the basin and a plan of action
- Educate people
- More research on water quality
- Building trust among communities
- Improve technology
- Policies should establish the levels of runoff and what can go back to the river
- Local efforts and methods for water management should be established
- Standards to monitor and control industrial effluent

Barriers:

- Social inertia towards change
- Insufficient understanding amongst people about water issues
- Inadequate methods to handle livestock waste

Aids:

- Oldman water quality initiative
- Farmers are adopting good practices

Ideal Future:

- Fish may still be able to thrive in the river in the future
- Less lawn irrigation
- Healthy trees in the river valley
- It would still be possible to go canoeing in the river
- New houses having low flow appliances
- Healthy community
- Thriving irrigation

Sid Marty

Interview by Emily Sentilles and Hilary Aten
Lebel Mansion, Pincher Creek, Alberta
January 9, 2006

Sid Marty is a journalist, author, and musician who has lived his entire life in the South Saskatchewan Basin along the Eastern Slope of the Rockies. He worked in the past as a park warden for the National Park Service in Alberta, obtaining hands-on experience in conservation. He also became involved in basin issues during the Oldman Dam fight, which deeply divided the community of Pincher Creek.

Mr. Marty hopes that the development of a holistic appreciation and respect for the Oldman River Basin and will result in a future with no water crisis and no impact from climate change. He hopes to see decisions based on science. Mr. Marty would like to see

a provincial wildlife park developed on the Eastern Slope of the Rockies, providing protection for the headwaters of the Basin.

He cites problems with water scarcity, as well as extreme events such as frequent so-called 100-year floods and long droughts. He states that these problems have been caused by over-allocation of water as well as decreases in source water from precipitation and winter snow pack resulting from climate change. In addition, increased growth and development along the Eastern Slope have contributed to degradation of water quality, through increased pollution and clear-cutting in the headwaters area.

If no action is taken to address these problems, Mr. Marty worries that the predictions of future water shortage will become true. He also sees potential for the control of water to become profit-based, becoming privatized without protecting the interests of citizens. In order to avoid these outcomes, he recommends creating plans based on the worst-case scenarios, erring on the side of caution in decisions regarding the Basin. He also states that accurate, science-based information needs to be used in government decisions and education of the public on pollution and water use issues. He recommends implementing conservation practices and evaluating irrigation water use by its method and purpose. He recommends considering the attachment of a "value price" to water, but only if it is managed by a publicly-owned entity and not a private corporation.

Mr. Marty states that the current political atmosphere and provincial government administration represent potential obstacles to achieving these goals in the Basin. He also sees the strong All-Terrain Vehicle (ATV) lobby as an obstacle to building the Eastern Slope Park. He cites the idea of "Doctrine of Multiple Abuse" as outdated and no longer viable to accomplishing current Ideal Future. Mr. Marty does state the area is rich in natural resources, including fossil fuels, wind power, and strong agricultural economy, which he sees as an aid to protecting land through mutual interest in future resources. He lists Shell Oil as a supporter of the Eastern Slope park idea. Overall, he is optimistic of the ability of a well-educated public to change direction and take action to address the problems in the Basin.

Problems:

- Economy threatened by water scarcity
- Water quality degraded
- Frequent floods a so-called "100 year" level
- Impending decade or longer droughts in future

Causes:

- Climate change
- Decline in precipitation and winter snow pack
- Clear cutting in headwaters
- Increasing pollution concentrated by decreasing water volume
- Public misperceptions of water availability
- Tendency to push for more growth, development
- Development along Eastern Slope

Consequences of No Action:

- Predictions of water shortage and climate change are true, or become even worse
- Control of water becomes privatized
- Dams fail

Potential Actions:

- Turn attention to plan for worst case scenario; err on side of caution
- Evaluate irrigation projects for type of crops, methods of irrigation, and purpose
- Implement conservation policies
- Attach value price to water, but only if publicly owned and operated
- Base government decisions on science
- Educate the public on pollution, water situation
- Engage in collaborative dialogue
- Commitment from all parties to work collaboratively

Barriers:

- "Doctrine of Multiple Abuse"
- Current leadership in provincial government
- Political atmosphere of anti-government involvement
- Limited staff in resource agencies (government)
- All-Terrain Vehicle lobby that opposes a park in river headwaters
- Steep learning curve for general public on issues

Aids:

- Area is rich in natural resources, fossil fuels, wind power, strong agricultural economy
- Educated society
- Shell Oil supports building of park in headwaters
- Ability to change people's minds, motivate into action

Ideal Future:

- No crisis, no climate change
- Wildlife park created in headwaters of the river along the Eastern Slope, to protect the quantity and quality of the source water
- Holistic appreciation and respect for Basin
- Establishment of Eastern Slope park in headwaters

Judy McMilan-Stewart

Interview by Emily Sentilles and Hilary Aten
Community Futures Alberta, University of Lethbridge, Lethbridge, Alberta
January 9, 2006

Judy McMilan-Stewart works for Community Futures Alberta (CFA), a provincially-distributed, non-for-profit network that receives federal funding to address rural development issues in Canada and seeks to increase education in rural areas. She grew

up on a rural farm, and her memories of sharing bathwater with her entire family led her to reflect on the situation of rural areas as the traditional "stewards of the land" and how these roles affect rural development.

Ms. McMilan-Stewart envisions a Basin future where citizens take ownership and responsibility for their local natural resources and for the global environment. She would like to see specific goals achieved, such as riparian setbacks, higher instream flow volumes, healthy river ecosystems, and rural and urban equity in water quality and allocations. In her work with CFA, she has seen some communities already face water restrictions, particularly in the South where more of the development occurs. She states that some of the decrease in water availability is due to global warming's impact on the source water of the Bow Glacier. She also cites a lack of urban understanding of the need for conservation, as well as increasing development and population pressures, for water shortages. In addition, she states that aquifers are being contaminated by oil and gas drilling in the area that permeates the aquifer.

If no action is taken to address these problems, Ms. McMilan-Stewart states that the South Saskatchewan River Basin could end up looking like the "Los Angeles River," more of a drainage ditch than water body, with disputes over moving water among users and allocation transfers. She also states that if nothing at all is done, violence could break out over water as the supply runs out. In order to avoid these situations, she recommends setting limits to growth, including monitoring potential new industries for responsible activity with reduced water use. She also emphasized the need for public education to involve individuals in conservation. She recommends looking to other water management examples worldwide, including demonstration of good and bad practices, to learn from others' mistakes and avoid the same fate.

She is concerned that excuses for inaction from the public, resulting from human nature's tendency to resist change, will act as an obstacle to accomplishing these actions. She also lists the scientifically inaccurate information in the public domain as a potential obstacle to achieving goals. Ms. McMilan-Stewart does state that there has been an improvement in public awareness of water issues, such as monitoring of feedlot operations. In addition, she states that Alberta Environment's practices of tight regulations and proper enforcement will be useful tools in accomplishing these actions. In addition, efficiency improvements in agriculture will help reduce the strain on water availability. Overall, Ms. McMilan-Stewart is optimistic about the role of citizens in improving management of the South Saskatchewan River Basin for the future.

Problems:

- Water restrictions
- Lack of water
- Aquifer contamination
- Damage to crops
- Decrease in species

Causes:

- Urban lack of understanding of conservation
- Public tendency to ignore intangible problems
- Development pressure
- Oil and gas drilling through aquifer
- Climate change

Consequences of No Action:

- "Los Angeles River"—the South Saskatchewan as a drainage ditch
- Water moving and transfers
- Fights over water when supply runs out, violence

Potential Actions:

- Monitor industrial activity for efficiency of water use
- Recruit citizen participation and action, not just industry and government
- Set limits for growth
- Education
- Learn from the mistakes made elsewhere
- Riparian setbacks

Barriers:

- Public perceptions often scientifically inaccurate
- Human tendency to look for excuses for inaction
- Resistance to change

Aids:

- Alberta Environment's enforcement record
- Improved public awareness
- Improved monitoring of concentrated animal feeding operations
- Improved efficiency in irrigation

Ideal Future:

- Sense of citizen ownership/responsibility for natural resources
- Respect for downstream neighbors
- Healthy ecosystems
- Rural and urban equity

Metrics

- Quality and quantity standards of the Water for Life strategy

Brent Paterson

Interviewed by Nishesh Mehta and Elizabeth Ojeh
Alberta Agriculture and Food, Lethbridge, Alberta
January 10, 2007

Brent Paterson is the head of irrigation in the Alberta Department of Agriculture and Food. His career has been devoted mostly to the management of the waters of the South Saskatchewan. He has been privy to many developments in the basin, the last major water storage development being the construction of the Oldman Dam. A current challenge is to be able to deliver the mandated 50 percent of natural flows to the province of Saskatchewan while meeting the future water needs of users in the South Saskatchewan River Basin (SSRB). There are agreements now to restrict the allocation of the Red Deer River, the only river in the basin not yet fully allocated, to 55 percent of the water in the river, with the remaining 45 percent be designated as in-stream flow. Currently only about 15 percent of the Red Deer is allocated. If demand continues to increase, there is a concern that flows will continue to decline, especially if water is not recognized as a limiting resource.

Mr. Paterson has observed some decline in water quality, especially in some reaches. The poor quality is now being resolved with the help of rural and urban communities, but the problem may become widespread if current attitudes and behaviors persist. However, water continues to be a driver for regional development, especially now that it is known that no new irrigation licenses will be granted. The recent 2001 drought may represent a symptom of the problem at hand. However, the other water users in the SSRB, even though the "first in time—first in right" legislation would allow the Irrigation Districts to use most of the water. Any permanent solution could be difficult, especially as the demand for water continues to increase. Most people are avers to changes in the legislation on the issue, and would immediately start looking for loopholes if new legislation was implemented.

The problem, as Mr. Paterson sees it, is that most people have emotional responses to water issues and there is no consensus as to whether water is really scarce or not. Thus there is a need to more accurately quantify how much water is actually being diverted from the system for irrigation and other uses. There is also the need to educate and raise awareness on conservation issues and the potential impacts on water supply and demand of climate change. Science and technology is helpful in providing an understanding the changes and in proposing better management strategies.

Mr. Paterson hopes that water users will be able to find an acceptable balance between aquatic ecosystems and economic development so that they can tailor the developments to the capacity of the system. There has been much research in the area of water, but not much on a basin wide scale, or long term. Hence, the government is now willing to fund research that integrates the work that has previously been done to facilitate a better understanding and unearth solutions. He hopes that they can find the required human resources to engage in the research needed to speed up the solution process. The solution

may include building more storage, but it is important that people shake off their apathy and be open to the changes that must be made to improve the basin.

Mr. Paterson reports that Alberta Agriculture, Alberta Environment and irrigation farmers are now working closely and sharing information to improve real time monitoring of information like weather, the partners now use the same software to ensure a seamless link between water supply and water demand. The Oldman Watershed Council hosts and makes informative presentations to communicate important information to participants. The requirement now is for incentives or legislation to encourage the replacement of lawns landscapes which conserve more water, such as was done in Las Vegas ($1 / sq.ft.).

Problems:

- Increase in water demands
- Water quality
- Research in this field not well integrated

Causes:

- Human resources dedicated to work with water and related issues are not always available
- Insufficient scientific knowledge
- Research is often not well integrated due to academic institutes following the "publish or perish" policy
- Reaction of people against legislation
- Climate change
- Increase in population

Consequences of No Action:

- Potential significant shortage in the future with an increase in demand

Potential Actions:

- Increase in efficiency
- Better use of technology
- Adapt to changes in water supply
- Conservation of water
- Balance in research and development to catch up to needs of today
- Decide whether expansion in storage capacity is required or not
- Closure of basin in terms of water supply
- Assessing what needs to be done with the remaining water
- Incentives paid to land owners who implement conservation practices
- Increase in science and technology
- A computer system which immediately notifies users if a problem exists
- More seamless integration of technology with agriculture practices
- A comprehensive water quality monitoring system in place
- Moving wintering sites so that no run off results
- Use of a mathematical model which measures and reports cumulative effects

- Implementation of Best Management Practices
- Use of confined feeding operation manure injection

Barriers:

- Apathy until four years ago
- Lack of integration in research
- Insufficient education to stakeholders

Aids:

- Minimum flow in the basin has been fixed by the government
- A previous example of collaborative effort to overcome drought
- Irrigation community has reassessed expansion plans in the wake of climate change

Ideal Future:

- Match development to water supply that takes into account a reasonable flow remaining in the river
- Reach a balance on how much water is available
- Economic development and ecological balance

Metrics:

- Crop growth and development parameters

Richard Phillips

Interviewed by Emily Sentilles and Hilary Aten
Bow River Irrigation District Office, Lethbridge, Alberta, Canada.
January 8, 2007

Richard Phillips is the General Manager of the Bow River Irrigation District, Alberta's third-largest irrigation district, which provides irrigation for farmers, water to towns, and meets the demands of other licenses. According to Mr. Phillips, the Bow River, which runs through Calgary, is too small a river to support the current rapid development occurring in the Calgary region. He feels that while there is plenty of water to use for municipal purposes, the river is too small for sewage assimilation.

Mr. Phillips's ideal future is for the Bow River Irrigation District to maintain or improve the quality of the water in order to provide irrigation quality water to license-holders. He would also like to see provincial-operated storage—not necessarily a new dam, but the province could purchase an existing, privately-owned hydropower unit—so that the river could be controlled not just for hydropower but also for water flows.

The two main problems Mr. Phillips sees are the water quality of the Bow River and a growing sense on the part of the public that Alberta is in the midst of a water shortage. The problem of water quality is caused by various factors, with Calgary's wastewater the single largest problem.

Mr. Phillips does not see that quantity of water as a problem in the river. He said the diversion of water to cities does not result in water shortages—the water that is used in the city is mostly returned to the water source. He stated that the lack of increased nutrients in the water leads to the growth of weeds in the canals and irrigation system that clogs the distribution system. He also discussed the impact of non-point source runoff that pollutes the river, but he said the largest problem was the point-source pollution.

Mr. Phillips reports that the media is mostly responsible for creating a sense of crisis about a problem that he does not see—a lack of water in the South Saskatchewan River Basin. The Bow River irrigation district has recently expanded by 10 percent; he reports that there is room for further expansion. Mr. Phillips explained that the crisis mentality is incorrect because currently human consumption of the water is only using 20 percent of the water in the rivers, on average.

Mr. Phillips' proposed solution for a best-case water quality scenario is for Canadians to agree to spend top dollar—whatever amount is necessary—in order to provide the best treatment of water used by urban populations and provide for a better future. Already, regulations have been established to establish total loading limits. He would like to see these protected and improved. He would also like to limit drainage from land into the irrigation canals. He noted that there is always room for more efficiency.

Mr. Phillips said that annual differences in the water flows, drought, and demand are all natural phenomenon. These are not rare occurrences in the history of water or the region. The prairie historically gets very little rainfall and is dependent on water in the rivers that flows from the snow packs, rain, and glaciers in the mountains. He would prefer for the province to invest in better control the water flows of the river, but not necessarily through the construction of a dam. He referenced the controversy over the Oldman River Dam. Mr. Phillips suggests measuring effluent discharged into the river and comparing contaminants versus guidelines for pollutants. He named the government restriction of new licenses as a challenge to managing the water issues on the Bow River, given the high demand for new allocations.

Problems:

- Water quality
- Misinformation regarding the water supply situation

Causes:

- Water quality and urban growth around Calgary; sewage
- Nonpoint-source runoff
- Misinformation to public—media looking for sensationalist story

Consequences of No Action:

- The canals will continue to be choked by weeds and algae, limiting efficiency, water flow, and clogging pumps and sprinklers

Potential Actions:

- Enforce established total loading limits

- Increase awareness of non-point run-off issues
- Limit drainage of land into canals
- Increased efficiency in irrigation
- Control river flow, not just create of hydroelectric power
- Spend for best treatment of sewage
- Recently expanded capacity of distributions to 10 percent; could easily expand more
- Minimum flows are better than they were 20 years ago

Barriers:

- Campaigns for urban conservation do not help; they lead to a belief that there is not enough water, when the real issue is reducing treatment and distribution costs
- Reservoirs along Bow River are privately owned for purposes of hydropower
- Water quantity: Bow River has no provincial-operated storage to benefit river flows

Aids:

- Only using 20 percent of the water in the South Saskatchewan River Basin
- Water taken out by Calgary does not reduce quantity, only quality
- The province could buy a private reservoir

Ideal Future:

- Reduce human impact
- Sustained water quality

Metrics:

- Concentrations or amounts of effluent in water
- Guidelines for pollutants
- Flow measurements to estimate nature events

Hugh Pepper

Interview by Zac Simpson and Charlie Stern
Exshaw, Alberta
January 9, 2007

Hugh Pepper is a member of the Bow River Council and a current resident of Cochrane, Alberta. He has previously been involved in the formulation of the Water for Life Strategy, as well as several other local government efforts to manage water in the Bow River Basin. Mr. Pepper would like to see a water management system underpinned by a "serious" desire to protect watersheds in a holistic manner. He suggests modeling such water management after several cities in the Northwestern U.S. (Seattle and Portland). He reports that the provincial government needs to do a better job controlling water and land uses in the upper reaches of the Bow River Basin, as that would aid in water recharge. Mr. Pepper reports wetland problems leading to an overall deterioration of the riparian zones in and around the Bow River Basin. Activities such as logging and the use

of gas-powered recreational vehicles have led to sudden flooding, as opposed to the slow release of groundwater over wetlands.

Volatile weather patterns caused by global warming and climate change have made water management more difficult. Mr. Pepper thinks that these volatile weather patterns in combination with inaction in the area of water management practices will create significant additional stress leading to risks of catastrophic events in the future. Mr. Pepper thinks that the incorporation of good science can prevent this somewhat, as can a better set of baseline data from which to conduct river management. Barriers to improved water management in the river basin, according to Mr. Pepper, have to do with public opinion and willingness to accept the realities of the current situation. Surveys of groundwater inventory, as well as measurement of in-stream flows and conventional water quality testing could become crucial measurement tools in evaluating improvement to the current water management system.

Problems:

- Overall "hardening" of the wetlands in Bow River Basin area
- Decreased water availability
- There is little knowledge concerning groundwater availability in the basin area

Causes:

- Beaver dams break down and cause water flows to increase, aquifer recharging to decrease
- Population increases stress the river
- People on their 4-wheelers scared the beavers away, leading to fewer beaver dams
- Continual use of fossil fuels contribute to global warming and increased variance in precipitation patterns

Actions:

- Build adequate feedback systems that will provide information concerning management practices
- Face the problems instead of trying to ignore them due to fear of the unknown
- Conduct proper research to learn more about the groundwater situation in the river basin
- Consider additional research to learn more about how wetlands are connected to the river basin
- Commit to the use of good science as a decision-making tool

No Action:

- A significant drop in water volume in certain areas of the river basin
- Increased variability will lead to river basin not being reliable water source for users
- More stressors may lead to problems down the road

Aids:

- Use of "good science" on the political level to lessen public skepticism

Barriers:

- Denial of current events and realities
- Public will in favor tough decisions

Metrics:

- Consider surveys of groundwater inventory and upstream aquifer recharge rates
- Conventional water quality testing and in-stream flow records

Ideals:

- Look at the watershed as an entity for protection (should include both subsurface and surface waters)
- Legislation can aid in the management process

Shane Petry

Interview by Emily Sentilles and Hilary Aten
Lethbridge, Alberta
January 9, 2006

Shane Petry has worked with the Government of Canada since the late 1990s and has worked as biologist for Fisheries and Oceans Canada (DFO) since 2000. DFO is a federal department responsible for protecting and managing aquatic habitats in Canada, including both inland and coastal regions. The department's primary role in Alberta is to regulate projects which may affect fish or fish habitat, provide information and advice on the mitigation of project effects, and to enforce regulatory compliance under the federal *Fisheries Act*. Mr. Petry is also personally active in issues affecting the South Saskatchewan River Basin, and he serves on boards and advisory committees for several watershed groups.

Mr. Petry would like to see greater collaboration among citizens utilized as a tool for land use planning activities in the SSRB. He hopes to see a future where water levels in the basin are increased to maintain healthy aquatic ecosystems. Mr. Petry sees the removal of water from rivers in southern Alberta as the major contributing factor to aquatic health issues. The largest volume of water taken from southern Alberta rivers is for agricultural purposes. A second contributing factor to aquatic health issues in the SSRB relates to water quality. Mr. Petry would like to see action taken to address these problems before they go beyond the point of restoration. He suggests that inaction could result in long-term sustainability issues and even situations where local users of water resources have limited ability to manage the resource.

According to Mr. Petry, society will have to decide how much degradation of Alberta's ecosystems is acceptable. In addition, he states that the environmental impacts of projects need to be assessed more accurately and follow-up monitoring must be undertaken to assess those predictions. Mr. Petry noted that there are other tools that can be utilized to address some of the water issues that exist in the SSRB, including stewardship as well as regulatory approaches.

Mr. Petry observed that a potential barrier to success in water management issues is that ordinary citizens are often not represented in consensus processes in Alberta, and are difficult to recruit for participation. In addition, DFO only regulates within its specific mandate pertaining to how a given project affects fish and fish habitat on a site-specific basis, as opposed to utilizing a broader planning function. However, Mr. Petry reports a positive change in public perception about the importance of conservation, which could help achieve success. New initiatives resulting from the development of Watershed Councils and the Alberta "Water for Life" strategy can also be used as tools. Overall, Mr. Petry is optimistic about the success of collaboration and other collective and regulatory approaches in ensuring a positive future for the SSRB.

Problems:

- Reduced instream flow
- Degradation of aquatic ecosystems
- Decreased water quality

Causes:

- Diversion of water
- Limited rainfall
- Contaminants in runoff and effluent

Consequences of No Action:

- Potential loss of local control
- Inability to restore water quality and quantity
- Water as commodity

Potential Actions:

- Collaboration
- Public involvement
- Accurate assessment of environmental impacts
- Regulation
- Public education on stewardship

Barriers:

- Lack of citizen involvement in consensus process

Aids:

- Changes in public perception
- Water for Life Strategy
- Watershed Councils
- Economic value of recreational fishing

Ideals:

- Comprehensive collaboration
- Increased instream flow

Metrics:

- Increase in instream flow

- Discharge goals for summer months
- Drinking and consumption water quality standards met or exceeded to ensure healthy ecosystems

Bob Sandford

Interview by Brandon Steinmann and Alicia Williams
Alberta, Canada
January 9, 2007

Bob Sandford is the chair of the United Nations Program "Water for Life" Decade Canadian Initiative. The mission at "Water for Life" is putting water into perspective. As a lifelong resident of the basin, Bob became interested in the South Saskatchewan River Basin. Mr. Sandford stated that there is a global water crisis and attributes this to the increase of agriculture uses, population growth and irresponsible irrigation practices. Mr. Sandford believes that Canada is currently under an "Al Capone Public Policy" view of water that states if no one moves, no one will get hurt. He believes that the social and economic development of Canada depend on managing water basins correctly.

In Mr. Sandford's opinion, water management actions need to be conducted in a way that transcends previous jurisdictional range and ensures inclusion of all stakeholders, not relying on old practices that keep users from resolving problems. Mr. Sandford believes that public collaboration is essential, empowering the people who are on the water basin councils and trusts to understand the situation so they can manage water effectively. He also encourages detailed records of the river's activities be carried out through available computer modeling and data analysis. Results should be written in language that any citizen can understand. Mr. Sandford stated that if no action is taken to help manage water in the South Saskatchewan River Basin, water conflicts could continue, leading to water shortages like those in the United States and limit economic and social development in Canada.

Mr. Sandford's ideal water management system for water is an integrated approach that considers all aspects of the river's flow. Specific steps include allocating enough water for ecological systems, ceasing contamination of waters, and changing social perspectives, such as a sense of "ownership" in industries and government regarding their stakes in water. He thinks that the government's role of discouraging people to take a role in water needs to change; the longer the wait for public participation, the harder it will be to take future action. Mr. Sandford argues for enhanced data collection and improved monitoring of water. According to Mr. Sandford, common definitions of key topics such as a healthy aquatic ecosystem, sustainability, and water quality standards are essential for measuring water usage.

Problems:

- Potential water shortages
- Inadequate in-stream flows

Causes:

- Old entrenched divisions of users
- Resistant to Change
- Population growth
- Increasing agriculture uses
- Pressure for increased development
- Dam diversion
- Withdrawal of river—reduction of flow
- Native American tribal impact
- Climate change will affect river systems
- People think status quo protects them... if no one does anything, then no one gets hurt
- "First in time, first in right" leases are not adequate to protect future needs

Consequences of No Action:

- More conflict among water users
- Continued disputes over water
- Canada will mimic how the U.S. manages water
- Limits on social and economic development
- Water volume will continue to decline
- Water crisis in Alberta

Potential Actions:

- Create a public management team that includes councils, trusts, government agencies, etc.
- New collaboration among parties
- Real time operations which include modeling
- More uses of water as a resource
- Management of water as a multipurpose solution
- Help everyone perceive their own stake in water resources
- More waste removal
- Assure sustainable use of river

Barriers:

- Detailed new water data needed
- Collaboration tools necessary and implement ways to put in model
- Ownership issues by some in industry and government
- A false sense of managing water "properly"
- Ignorance

Aids:

- Finding good examples of modeling ground water
- Many solutions already exist; many models already exist; computerized irrigation techniques can help manage supply
- Awareness of water and what it means in the community

Metrics:

- Definitions and performance levels for "sustainability," "aquatic eco-health," and "water quality"
- The volume of future leases
- Knowledge of basic standards and of re-use

Ideal Future:

- Break down of old adversarial entrenchment
- New collaboration among parties
- Transcend legal barriers
- Expand public involvement
- Increased data collection
- Better monitoring practices
- Computer assisting with modeling
- Proactive way of tackling problem
- Develop ways to management availability of water

Bob Tarleck

Interviewed by Nishesh Mehta and Elizabeth Ojeh
City Hall, Lethbridge, Alberta
January 11, 2007

Bob Tarleck, Mayor of Lethbridge, has been involved in many of the city's water management initiatives. According to Mayor Tarleck, water is not a new issue in the region, as John Palliser observed at the start of the last century that the land is too dry to support humans. However, with the innovations in technology, the land not only supports humans, it also supports an extensive regional agricultural industry. Mayor Tarleck believes water is important and the rivers should be managed on a basin wide basis, especially now that the glacier region is being degraded and receiving less snow.

Mr. Tarleck cites as evidence for reduction in water quantity the fact that the South Saskatchewan River Basin (SSRB) used to contribute 30 percent to the Nelson Basin System and now only 22 percent comes from the SSRB. Previous management and conservation measures employed until now have been short-term and ineffective. One reason for this is that long-term measures are expensive, thus there is a need for the federal government to step in and help with funding. A real solution would involve institutionalizing environmentalism and developing a science-based mechanism for determining water allocation.

Mr. Tarleck reports that the region has seen tremendous growth recently, and has been characterized as the second fastest growing economy in the world after China. With such growth, Mayor Tarleck is concerned that desertification of the farmland areas may get worse and result in a system collapse if the present rate of growth continues without regard to the state of the environment. He therefore thinks that stewardship of the water resources is important as it is not possible to live sustainably outside the environmental

envelope. The city is already one of the leaders in water treatment with an award-winning water treatment plant. The city now actively encourages mulching and xeriscaped yards.

Mr. Tarleck added that for these efforts to be successful there must be political and public will to do right. There must be flexibility, as having a water license is no guarantee of getting water 10 years in the future. For example, golf courses that use a lot of water and manure (which get washed into the river with runoff) need to reconsider their water management practices. They might be able to replace the surrounding areas that are not used for golfing with more desert-like landscapes.

The future Mayor Tarleck hopes for is one in which waste-energy projects for converting livestock waste to fertilizer will be in use to reduce the manure that washes into the rivers as runoff. He also hopes that fewer people will be washing their cars in their driveways and farmers will keep their livestock away from the rivers. The mayor believes the city has been fortunate because many of the residents belong to families that have been in the region for generations and this made it easier to form the partnerships required for success.

Problems:

- Water resources strained
- Water quality and quantity a historical concern
- Degradation of glacial fields
- Decrease in the quantity of water in the South Saskatchewan

Causes:

- Global warming
- Golf courses consume a lot of water
- Weak political will
- Water as an issue does not hold widespread recognition

Consequences of No Action:

- Society not sustainable
- Farm operations will shut down
- Food processing not possible any more
- Abandonment of small communities
- System will collapse like Haiti

Potential Actions:

- Careful stewardship of environment
- Creative and innovative solutions to solve problems
- Strong federal and provincial leadership
- Effective landscaping efforts
- Manage feed lots and waste
- Implement waste-derived energy systems
- Need to find the long term good of the society

- More strategic use of water
- A consistent mechanism to resolve conflict
- Institutionalize environmentalism
- Waste-energy becoming part of the solution
- Mulching
- Decide on how much water can be withdrawn from the river system

Barriers:

- Greed
- Blindness towards facts

Aids:

- Waste water treatment plants
- Storm water retention plants
- Natural trees and landscaping
- Xeriscaping
- Waste-energy systems
- Green subdivisions and having water as part of those plans

Jim Webber

Interview by Emily Sentilles and Hilary Aten
University Hall, University of Lethbridge, Alberta
January 8, 2007

Jim Webber is the general manager of the Western Irrigation District in Alberta, Canada. He has a background in engineering and has worked for various irrigation districts within Alberta, including the Eastern Irrigation District. The Western Irrigation District is on the Bow River and sits just east of Calgary.

The current problems for the irrigation district include poor water quality, poor efficiency and disrepair of the irrigation district infrastructure, and conflict created between the urban expansion of Calgary and the agricultural use of land. These problems reflect the fact that the district is next to Calgary and its urban sprawl. The Western Irrigation District's main pollution problem stems from runoff from storm drainage from the city. When there are large storms, there is insufficient control over the amount of storm water flowing into the river; there have been floods in the irrigation district as a result. Storm runoff contains contaminants from city water users, from trash to oils (from cars on the roads) to domestic fertilizers. These have an effect on the quality of the river and lead to algae growth that disrupts the efficiency of the irrigation system. The expansion of Calgary and the desire of developers to convert agricultural land into urban or suburban development leads to conflict over access to water: where the licenses will come from as well as the impact these development have on the quality of the water. An unforeseen problem, according to Mr. Webber, is what will be the effect of global warming. He wonders if receding glaciers will lead to a need to use less water or to have better systems for the timing of water releases from the mountains.

Mr. Webber reports that Western Irrigation District is in disrepair. The district does not have a large enough tax base to support all the repairs the district needs. As a result, he is contemplating ways for the irrigation district to increase revenues. Mr. Webber's preference is to have irrigation-quality water throughout the district, which would require communication among water users. Some of the actions the Mr. Webber would like to see include converting the irrigation canals of the district to pipeline, garnering revenues from the conversion of agricultural land to urban use, smarter regulation of water transfers, and changing the Water Act laws. Aids to these actions include knowledge of the law. Mr. Webber said that more and more boards and irrigation districts are demanding the presence of lawyers at all times. Another aid to addressing the conflicts of land conversion is communication among all parties.

The barriers that Mr. Webber perceives between the city and the irrigation district are the frequency with which people are turning to courts to resolve these problems and the lack of planning to oversee Calgary development. He reports that some developers who are not mindful of the impact or costs to the irrigation district are pushing through development. He believes better planning would resolve some of the conflicts that are created as a result. Mr. Webber said that a committee has been formed between the irrigation district and the city in order to resolve some of the issues.

The worst case scenario Mr. Webber foresees would occur if the current situation remains or gets worse: Canada could look like the United States where many conflicts are resolved through litigation. He believes this would affect water quantity for license holders first. Another possible poor outcome would be for Calgary to grow beyond the capacity of the Bow River to sustain it.

The metrics Mr. Webber proposed for measuring the success/failure of future management of the basin involve water quality standards, such as average limits for phosphorous, fecal matter, or solvents in the water. Metrics for building the irrigation system to a higher standard would include incentive programs for farmers to improve equipment, or pump ponds on the irrigation system. He also suggests the numbers of planners involved in Calgary's growth and conflicts between the district and the city could be a measure of success.

Problems:

- No economic base or source of taxes to support maintenance of irrigation district
- Low efficiency because irrigation infrastructure is poor
- Water quality issues because the district is downstream of storm water drainage system from Calgary
- Conflicts regarding water rights/usages because of urban expansion
- Flooding from storm runoff

Causes:

- There is not enough economic density to manage the system effectively—system is too spread out
- Irrigation infrastructure is poor and in need of repairs and upgrades

- Spread out system reduces efficiency
- Storm water runoff from city is redirected into the river without treatment
- Urban expansion is affecting water quality

Consequences of No Action:

- If there is no action, resolutions of conflict can only be achieved through court litigation
- The quantity of the water in the river will be affected first
- The city will grow beyond the capacity of Bow River
- Calgary could end up paying farmers not to irrigate and brokering water to a higher valued use

Potential Actions:

- Converting canals to pipelines
- Creating money by conversion of irrigated land to urban use
- Change laws—Water Act
- Smarter regulation of water transfers
- Communication among all water users
- Education
- Low-impact development, where the volume and quality of river remain the same

Barriers:

- Irrigation district is sitting next to Calgary with much growth

Aids:

- Knowledge of the law (lawyers are now always present at council meetings)
- Committee with City of Calgary to resolve some of development issues
- Incentive programs for farmers to improve equipment; pump ponds, for example

Ideal Future:

- To maintain irrigation quality water
- Wants planners to design growth rather than allowing poorly-controlled development

Metrics:

- Water quality measurements for the standards of phosphorous, fecal matter, solvents
- Higher standard for the irrigation system

Jay White

Interview by Alicia Williams and Brandon Steinmann
Edmonton, Alberta
January 10, 2007

Jay White is president of AQUALITY, an environmental consulting company in Edmonton, Alberta, Canada. He has substantial experience working with water quality and quantity especially with the Bow River Basin as well as the Oldman River. He worked on a report about the Bow River Basin that was completed in 2005. A copy of this report was given to the LBJ School of Public Affairs.

For Mr. White, the current state of the situation of the South Saskatchewan River Basin is both legal and political. He believes that irrigation is a cause of a possible problem of water shortage and over-allocation, as well as population growth, outdated irrigation practices and increased agriculture usages of the land. Mr. White believes there are several actions that can be taken to alleviate this problem, such as ensuring better management of agriculture waste, an increase in government involvement, stricter enforcement of laws, and maintaining wetlands.

A huge barrier that Mr. White could foresee is defining who is in charge of regulating the laws and uses of how people dispose of waste and use the water. He thinks there is an unclear definition of who is supposed to enforce regulations. Mr. White believes that watershed planning is critical for every community member to be involved in to identify issues (Bow Basin council a good example of this). If no actions are taken, then Mr. White sees this as water quality issue. He says that the past decisions that have been made 100 years ago are making an impact on what is going on today. Mr. White suggested entities such as Ducks Unlimited, "Living by Water," "Inside Education," municipalities, planning agencies, and PFRA CANADA (Prairie lands Farming Restoration and Agriculture) are crucial to watershed planning. For Mr. White a possible solution to a water shortage is defining what needs to be measured in water usage. This would involve working with representatives on what they think is the issue and defining inter-basin transfer legislation that will need to include the community as well.

Mr. White suggested several performance measures for water usage. These include indicators such as ASWQI (Alberta Surface Water Quality Index). Currently, there are only two long-term water quality stations in the 18 sub basins of the North Saskatchewan River Basin. Mr. White stated that an informed public, understanding the laws dealing with water usage, and managing wetlands are crucial for an ideal management plan.

Problems:

- Pollution in sub-basins—how will we manage agriculture?
- Agriculture waste
- Loss of land mass
- Decrease in water quality in South Saskatchewan Basin

Causes:

- Increase in urbanization
- Irrigation issues—slow change in techniques
- Agriculture intensity; production increases to sustain meat drive
- Quality: agriculture intensity through bacteria, pesticides

Consequences of No Actions:

- Less wetlands will have a negative impact on planning

Potential Actions:

- Managing waste on site; buffer zone on creeks and water sources
- "Municipal Government Act" politically sided
- Improve agriculture practices
- Maintain wetlands them through drain inventory, prioritize key as wetlands to provide ecological services; lower bacteria levels

Barriers:

- Huge bureaucracy

Aids:

- Advocacy

Ideal Future:

- Inform local public about water shed management
- Inform local public about repairing areas
- Managing wetlands to inform the public of ecological functions and value that they provide

Metrics:

- Sixteen indicators have been created to measure how to better demonstrate water usage (only eight have been implemented)
- What do we want to measure? Reference of the Oldman Report is a good start to look at outputs
- How do we define laws? Basins with water act
    - Total phosphorous bacteria; media indicators
    - Alberta (ASWQC) Reports about 18 sub basins concerning the water quality in basins. Only four have data or are maintained
- Do we have effective shed planning? (Bow Basin Council)

Gordon Zobell

Interviewed by: Nishesh Mehta, Elizabeth Ojeh, and Marco Campos
Raymond Irrigation District Manager, Lethbridge, Alberta
January 8, 2006

Gordon Zobell is the manager of the Raymond Irrigation District in Southern Alberta. The Raymond District receives its water from the St. Mary's water system that originates near Waterton, Alberta. The original system that brings water to the area was built in the late 1800s. In 1925 the Raymond Irrigation District was created when land was purchased from the Alberta Railway and Irrigation Company. The district is comprised of 46,000 acres that produce crops such as barley, cattle feed, oilseeds, and alfalfa. Mr. Zobell's interest in water stems from his long history in the region as a small farmer. His family has lived in the district for several generations. Though he does not have a college education in engineering, he prides himself on his common-sense, grassroots knowledge of the water needs of his community.

Prior to 1950, residents in the Raymond Irrigation District were tied to the St. Mary's river flow. This meant that farmers downstream had no control over water availability. Though farmers were scheduled to divide water, there was not enough to satisfy demand. The district's ability to grow and expand was limited. Conflicts among farmers over water usage were frequent. These conditions led to the building of the St. Mary's reservoir in 1950. The reservoirs solved the supply problems, as the district could then store water and distribute it as it saw fit.

Mr. Zobell characterizes the past two decades have been characterized by conflict between the interests of environmentalists and those involved in agriculture. Environmentalists argue that the use of reservoirs and dams affect adversely the ecological system of the river and eliminates and alters some of the natural habitats in the region. Mr. Zobell believes that water availability should be used to enhance the quality of life of those who live in the area. He believes the benefits gained from building the reservoir greatly outweigh the negative impacts on the environment.

The water problems that Mr. Zobell identifies are tied to the current irrigation system: water seepage, algae, evaporation losses, and nutrients washed into the reservoir after heavy rainfall. These problems are caused by the use of open air water ditches that transport water throughout the region. Another problem with the current system is that it relies on pressurized water pumps that run on fossil fuels.

To solve these problems, the Raymond Irrigation District has implemented the use of pipelines to divert water to farms throughout the district. The District plans to divert water from higher elevations to lower lying areas in order to eliminate the need for pressurized systems. This system creates another problem—natural habitats are damaged because pipes do not allow for water seepage that creates marshland. The pipeline plans have intentionally allowed seepage in historical marshlands to preserve some habitat. Though the District is well on its way to completing its objectives, Mr. Zobell acknowledges that the primary barrier to converting to the pipe system is money.

Another limitation of the pipe system is that once constructed, expansion is limited unless already designed into the system.

Mr. Zobell reports that most water users are supportive of the pipeline projects. The Raymond District has the support of the Alberta provincial government, which pays for the bulk of the initiative through a cost-share program. To open the lines of communication between environmentalists and farmers, the Basin Advisory Committee provides information to all involved parties. According to Mr. Zobell, even those once staunchly opposed to the district's development plans are now supportive, as a result of the Committee's work and because of a general consensus that the initiatives have been beneficial. Environment-friendly development, such as the use of water channels to generate energy, have also helped diffuse conflict with environmentalists.

Mr. Zobell is optimistic about the water management policies the Raymond Irrigation District has adopted. Failure to continue with the current plans would result in inefficiencies that should be remedied. To ensure positive future development, Mr. Zobell would like to see fewer steel-wheeled sprinklers being used for irrigation. He would also like to see an increase in pivot systems, more accurate application of water levels, and the phasing out of flooding for irrigation.

Problems:

- Algae
- Evaporation
- Seepage
- Nutrient deposits
- Conflict with environmentalists
- Loss of natural habitats

Causes:

- Nature
- Open air channels
- Heavy rain
- Loss of natural habitats as a result of irrigation systems
- Irrigation systems

Consequences of No Action:

- Inefficiencies

Potential Actions:

- Pipeline system
- Intentional seepage to create or maintain habitats

Barriers:

- Money
- Limits to expansion

Aids:

- Government cost-share program
- Public supports initiatives

Ideal Future:

- Return to grassroots planning

Metrics:

- Level of growth
- Number of pivot systems
- Number of steel-wheeled sprinklers
- Frequency of flood irrigation
- Number of open ditches eliminated
- Storage capacity for peak flows
- Amount of water conserved

Alberta Environment Headquarters Employee
Calgary, Alberta
January 12, 2007

Problems:

- Water has been fully allocated
- Effluent discharge and water quality issues becoming more prominent

Causes:

- A fast-growing economy in the river basin places stress on the resource
- Increasing demands and usage by commercial and industrial sectors
- More nutrient loading in the river as a result of industrial discharge

Consequences of No Action:

- Increasing "fights" over water in the city and no water available in some of the outlying basin areas
- Increased stress on the already degraded river pose serious risks for long-term ecosystem management
- Much tension among stakeholders

Potential Actions:

- Define sustainability and incorporate those concepts into management of the river basin.
- Attempt to determine a priority order among stakeholders that can be used to allocate water rights more efficiently
- Educate the public that water might not be as much of a renewable resource as had once been thought
- Obtain knowledge concerning the water system in the basin that takes into account the interaction between surface and subsurface water

Barriers:

- Arriving at a consensus among contentious, competing value systems will be difficult
- Lack of information and knowledge of what the water system "looks like"

Aids:

- Incorporate local expertise into the decision-making process
- Baseline data can be used to show the need for proper management systems
- Existing research concerning the capacity of the river basin could be coupled with new research to save time by speeding up results

Ideal Future:

- That the rivers and watersheds should be managed to continue indefinitely
- Collaborate among stakeholders to design a comprehensive management strategy.
- Management to create a thriving fishery and riparian zones.
- Use a regional management structure to gain societal support

Metrics:

- Data information systems that provide baseline information can be evaluated for change and prominent trends
- Various measures for water quantity and quality incorporated into performance management measures for water allocation

Anonymous Stakeholders

Problems:

- Water quality is getting worse with increased algae and nutrient levels in the river
- The Bow River is completely allocated, which will place limits on growth and usage strategies in the future
- Water quality has become a concern
- Decreased flow in some streams
- Fish unable to survive in some streams
- Receding glaciers in the headwater areas
- New compounds affecting water quality
- Potential for more problems in the future associated with drought
- Change of flow and how it affects the agriculture system
- High water evaporation
- Use of water in the oil industry
- Groundwater will become scarce if it is over-used
- Possible droughts
- Difficult to take measures that are unpopular even to protect water
- Ground and surface water needs to be examined
- Develop a tool of managing water usage

- Holistic problems, including an overall deterioration of aquatic health in riparian zones
- Health of the cottonwoods is important for the basin; they are experiencing regeneration problems
- Water quantity is the key problem with low river flows
- Degraded quality in the lower portions of both the Oldman and Bow Rivers
- Aquatic ecosystems continue to see decreased rating in the lower portions of the rivers
- Potential for extreme events and water levels to be highly variable
- Downstream water quality has deteriorated steadily over time
- Intersection of supply/demand requirements; current system unsustainable over the long-run
- Degradation of water quality in the river system, especially at the confluence with the Oldman River
- Dropping aquifer levels show that subsurface water and surface water in the basin could be inter-related
- No current crisis on the Bow, but there have been some times of water shortage
- Timing of high water flows could come too early in the year
- Potential extreme floods, erratic water flow
- Degraded fish habitat, through low dissolved oxygen
- Aquatic weed growth in canals; nutrients dumped into the system from the city leading to lots of algae in the irrigation district Quality
- Water levels may be going down
- In-stream flows reduced drastically
- Difficulty in reopening of negotiations among the three regions (Manitoba, Saskatchewan, and Alberta)
- NAFTA and WTO entitled non-Canadian investors to sue the Canadian government, a right not enjoyed by Canadian citizens resulting in differential treatment of these investors as compared to citizens
- International agreements might force policy changes that are not in the best interest of the residents of Alberta
- International agreements might force in export of water belonging to Canadian citizens
- Low rain can hamper treaty and perception on the U.S. side that the water release into the river by Canada is not fair because it may be less than the amount stipulated in the treaty
- Water quality
- Overall “hardening” of the wetlands in Bow River Basin area
- Decreased water availability
- There is little knowledge concerning groundwater availability in the basin area

Causes:

- Population in the Bow Corridor continues to grow, which pollutes and stresses water resources
- Increased industrial density in the region is requiring more water

- People have a mindset that prevents proper management of the river
- Canada has been spoiled in the past with abundant water supply, which causes people to not have a conservation mentality
- Runoff from increased development upstream
- Inconsistent water policies
- Inefficient shut off mechanisms
- First in time, first in right policy
- Lack of “buy in” for water allocation
- Water allocation is made in large blocks
- Water infrastructure takes water out of river
- Increased population growth in the South Saskatchewan River Basin continues to place stress on the resource
- Climate change affects water via precipitation
- No longer seepage into groundwater from irrigation canals
- Over allocation of water and resources in basin
- No knowledge of how much water is used
- A lack of monitoring of agricultural use
- Over-allocation of water and resources in river basin
- Growing population
- Diversion of Highwood River to help irrigate agriculture
- There is no water to spare
- People do not recognize water as a finite resource
- A lack of water metering
- New development in agriculture requirements
- Climate change
- High rate of water evaporation
- Dams and diversions leading to low river flows
- More water allocated by government than is practical because of a lack of holistic management
- Governments have allowed grandfathered users to maintain licenses
- A legal system is in place that does not protect the river
- Pharmaceutical byproducts and storm water runoff degrade water quality
- Under-valuation of water quality and upstream area for uses such as recreation, recharge, etc.
- Population growth places stress on the river system
- Economic growth in the province increases the different activities that affect the river basin
- Development along the riparian zones in wetlands and recharge zones adversely affect water
- Cumulative effects and managing to mitigate them Climate change (melting snow pack, increased water temperatures, extreme weather)
- Nutrients from effluent, runoff
- Urban planning not able to keep up with growth in Calgary
- Increase in water needed to flush effluent

- Global warming
- Growth in Calgary leading to city effluent downstream of Calgary.
- Cities have first priority of water
- Improper fertilizer spraying
- Highly chlorinated water in town
- Insufficient snow in the mountains
- Policy being formulated without heed to the changes in the international laws and agreements
- Very old water resources management techniques that are ill equipped to deal with rapid changes in international laws and technology
- Constitutional claim by three regions (Manitoba, Saskatchewan, and Alberta) to the same river water
- Changes in international laws and new treaties like NAFTA and WTO
- Global warming
- Bow glacier receding very fast
- Increasing demands by various users, such as industry
- Discharges to the river contain far greater array of chemicals than before which the natural system is not equipped to handle
- Water was never made part of the official treaty in NAFTA
- Policymakers refusing to accept that water is a commodity
- Beaver dams break down and cause water flows to increase, but cause a decrease in aquifer recharge
- Population increases stress the river
- People on their 4-wheelers scared the beavers away, leading to fewer beaver dams
- Continual use of fossil fuels contribute to global warming and increased variability in precipitation patterns

Consequences of No Actions

- Something has to be done or consequences will get worse
- If nothing is done in the present, there will be many problems that should have never happened
- Increased risk of shortages
- Negative effects on the ecosystem, such as reductions in trout fishing, as the health of species declines in the river
- Downstream populations would be affected adversely by poor water quality upstream
- A rigid rule-making system would develop and not be as effective as a system that was implemented prior to a crisis
- Reliance on rationing could be a reality
- More cataclysmic events will occur, such as the drought of 2001-2002
- Disappearance of Bow river flows
- Fish will die and eco-system is harmed
- Will lead to emergencies where government has to ration water
- Will lead to industry cutbacks
- Create a decline in snow melt that reduces low flows

- Environmental quality along the river systems will degrade
- Agriculture producers will feel the pinch when their irrigation waters are no longer available in the necessary quantities
- Degradation of the river system that will effect many generations
- Costs to undue damage
- Declining groundwater table will be hard to reverse
- Water shortages likely to occur at some point in the future Water shortages at times, such as late summer
- Glaciers will continue receding
- Water quality of entire river will be degraded
- No quality water to drink
- No water for irrigation
- A significant drop in water volume in certain areas of the river basin
- Increased variability will lead to river basin not being a reliable water source for users
- More stressors may lead to problems down the road

Potential Actions:

- Continue to support Alberta's Water for Life Strategy
- Convey to stakeholders that water might not be a renewable resource in a specific region
- Use baseline testing that will indicate the current water situation and use data to set goals for the future
- Awareness campaign
- Hold water users accountable
- Meter usage
- Redesign rate structure
- Mandatory use of water efficient fixtures
- Better technology
- Centralized principles of management for the surface water system
- Education on how property rights could change with a new market system
- Develop planning mechanisms
- Ensure development does not exceed demand for water in excess of available supply
- Create better water transfers plans, especially allowing government to withhold a larger percent of the volume transferred
- Approve water basin plans
- Meter water in all industries
- Companies must look for saline water before they use fresh water
- Search for "win-win" compromises based on general agreement regarding scientific/technological issues
- Realize that different groups use different tools, but those tools can be compatible with other interest groups to manage water
- Encourage people to agree on the central issues
- Communicate among groups, as people are not talking together enough currently

- Implement market mechanisms and water pricing
- Model the entire water system and experiment with various hydrological scenarios
- Look for market mechanisms, such as pricing for water or paying someone not to divert water
- Improve efforts to conserve and reclaim/recycle water so that both water quantity and quality levels are augmented
- Implement regional planning as a water management strategy
- Integrate ideas of environmental stewardship into an economic framework for water planning
- Set objectives for water quality and begin reporting
- Align conflicting government policies
- Close rivershed to new licenses to "limit" usage to current levels
- Restrictions on growth pushes "intersection point" of supply and demand further into the future
- Properly fund and implement Water for Life Strategy
- Conserve at least 10 percent of the river's rate for future growth
- At least one reservoir capable of storing water for one year supply, or at least enough capacity to capture peak flood flows in the spring to release in low flows in late summer
- Limit water allocation, licenses
- Work collaboratively with all users
- Build storage sites on the river
- Wetland mitigation (such as zero-loss in Calgary)
- Educate public on pros and cons of dams
- Low pressure pivot irrigation
- Incentives for conserving water
- Pipelines in district instead of open canals
- Buffer around the supply—both for drinking and for irrigation canals
- Increased use of improved technology in farming
- Analysis on how habitat and ecosystem would change in the wake of greater demand and scarcer supply
- Status quo in management of South Saskatchewan needs to be reexamined
- Renegotiation of treaty among the three states
- A need to reach a compromise for better and more equitable distribution of water resources
- Assessment of water quality
- Discovering scientific solutions to mitigate pollution problems
- Use of scientific methods to find more information about the resources present at this moment
- Ascertain what the balance is between leaving water in the river and using it in various industries
- A legal inventory that takes into account international rules
- The emergence of the practice of water bans

- Serious dialogue between federal and provincial government
- Proactive policy in place which legislates the use of conservation of water by using eco-friendly technologies and appliances
- Educating people and getting them to do the right thing by hitting their pocket books, such as fines and high prices of gasoline
- Build adequate feedback systems that will provide information concerning management practices
- Face problems instead of trying to ignore them due to fear of the unknown
- Conduct research to learn more about the groundwater situation in the river basin
- Consider additional research to learn more about how wetlands are connected to the river basin
- Commit to the use of good science as a decision-making tool

Barriers:

- General public misconceptions of issues
- High cost of implementing irrigation technology
- Public involvement slows down implementation of Water for Life
- Environmentalists wanting to leave more water in the river
- Economic costs of implementing plan
- Calgary does not have water meters for individual consumption
- Oil companies use a lot of water and the Stamp family questioned how that use affects river water quality
- The issue is a political hot potato (i.e., if public knows that water will be forcefully exported then it will cause an uproar and hence this issue does not receive the media footage it needs)
- Denial of current events and realities
- Public will not favor tough decisions
- Lack of education in the general public might prevent the importance of adequate water management being a priority
- The Bow Corridor has been "spoiled" with too much water
- Difficult both to admit there is a problem and agree on a solution
- The identity of the final decision maker's decisions and respect for those decisions
- Lack of strategic, long term planning objectives
- Politics: public and political disconnect
- Public perception of benefits
- Limited funds
- Lack of clarity with respect to jurisdictional areas and authority on water rights
- Lack of public knowledge concerning proper conservation techniques and water management
- Insufficient knowledge of the role that groundwater plays in the Saskatchewan River Basin
- "First in time, first in right" no longer applicable
- Government reluctance to act until crisis or public support to action

- There is no single "fix all" solution that can be taken, so it becomes difficult to convince stakeholders of necessary actions to be taken
- There is a fear of sharing information among stakeholders, such as the amount of water each has available through water licenses because each feels that the other will call for reductions
- Government may not demand that people come together to search for compromises
- Perception that rule of first in time, first in rights is a barrier to bringing license holders to the discussion table
- People could be in denial with what is currently happening and what might happen in the future with respect to water in the basin
- There isn't a definite linkage between economic and ecological incentives
- There is no single silver bullet that will solve all of the problems
- Mapping development for the next 50 years could be difficult
- Political risk could occur for policy makers who stand up for proper management
- Public awareness and education of current problems
- Resistance to any curtailing of unrestricted urban growth and/or limits on water usage

Aids:

- Use technology to increase the amount of information available to stakeholders and the general public (people need to be aware of water management issues and how technology can help)
- Increase contact with and the visibility of civil society organizations involved in water planning
- Public acceptance for several management measures
- City Council has interest in watershed protection
- Regulations by senior governments
- Watershed Council
- Citizens' participation movements
- Increased monitoring of both water quantity and water quality measurements
- Support networks and watershed groups (including financial support networks)
- Consult First Nations for historical knowledge relating to water management
- Price on water for industrial needs
- "Water master" agreements and other collaborative management efforts
- Use of quality science to inform government decision-making
- Volunteer groups with adequate funding can assess the river
- Research groups with adequate funding can address cumulative effects
- Examine previous cumulative effects assessments
- Empower local leadership groups
- Distribute/utilize Bow River Basin Water Management plan more widely
- Information available on Internet, other more traditional media sources (newspaper, TV, etc.)
- Outreach programs by electric utilities
- Population more aware of water issues today

- Zero-loss wetland mitigation strategy in Calgary
- High standards of wastewater treatment in Calgary
- Irrigation has not consumed more water as district has expanded
- Improved efficiency in irrigation
- Water for Life strategy measures
- Problems manageable if people are proactive
- Regulations in cities
- Specific ordering of quantities from irrigation district reduces waste
- Cities doing their best to be stewards of the resource
- Alberta's Environmental Farm Plans (private company) develops completely voluntary plan for farmers to improve environmental impact; it involves matching programs and incentives; started by farmers
- Good working relationship between irrigation district boards
- Huge cost to pump water (leads to more conservation)
- International Joint Commission set up in 1921 between Canada and USA
- Use of "good science" on the political level to lessen public skepticism

Ideal Future:

- Movement from open channels to pipelines for irrigation use to increase irrigation efficiency
- Water for Life strategy is a good start, but it will be hard to agree on solutions
- A management system (such as the Environmental Farm Plan) that rewards environmental stewardship
- Increase efficient irrigation methods that don't employ pumps and mimic rainfall
- Break-even water policy
- Multi-stakeholder approach to water allocation
- Document measure of flow in and out of plants and reservoirs
- Expansion of water networks comes at cost of developers
- Reduced reliance on irrigated agriculture to benefit of aquatic system
- Water usage would be below average for comparable size cities
- City would reduce its "footprint" and be seen as example of a responsible participant in watershed protection
- A monetary value to water that accounts for relative values
- Build a system that incorporates resilience and considers more than yearly average flows
- Price water; industry needs to pay
- Companies must look for water before they use current fresh water
- Meter water in all industries
- Restore industry flow needs to ensure they stay healthy
- Education of public and industry
- Government should review "first in time, first in right" rules and price in water
- Watershed basins need the best information to make informed solutions on usage
- Necessary facts and figures from government entities

- A management system that allocates water rights with the preservation of the environment as the primary goal
- An adaptive management system that can change with emerging situations and issues
- Government has the discretion to set limits that users cannot exceed
- Sustainable community planning with adequate water storage that allows for extreme events
- Give more attention to waste water reclamation
- Consideration to both on and off-stream storage Close the Bow River to new licenses
- Continue with Phase II of the Bow River water management plan
- Inform people that surface waters have a carrying capacity
- Storage on Bow to mitigate high flows and release water during times of low flow
- Calgary continuing with high standards of water treatment
- Constructed wetlands to help wildlife and mitigate drought periods
- More water conservation (storage)
- More people using environmental farm plans
- Water should be just as clean when put back into system as when taken out
- Look at the watershed as an entity for protection (should include both subsurface and surface waters)
- Legislation can aid in the management process

Metrics:

- Baseline testing
- Test wells and springs through subsurface water monitoring
- Test irrigation water for nutrients (such as chloride)
- Water rates
- Per capita water consumption and targets
- Levels of phosphorus, nitrogen, biosolids, and sludge
- Value to society that a specific water quantity provides
- Values of crops
- Per-capita urban water demand for water in urban settings
- Population growth
- Value of water to users
- Health of trout fishing industry
- Water quality performance measure
- Water quantity performance measure
- Pay attention to pesticides and other run-offs
- Create general progress indicators, which includes water quality and water quantity measures
- Ensure freshwater in aquifers
- Surveys that indicate satisfaction with the management system can be issued to all stakeholders
- Set up indicators and benchmarks that adequately measure this satisfaction

- Health of cottonwood trees
- Performance measures of aquatic health
- Water quality measures
- Incorporate some sort of “balance sheet” for baseline regional water inventories
- Need real-time price metrics to provide proper resource valuation
- Water quality metrics and related data
- Look at subtle indicators of ecosystem health storage capacity for peak flows
- Amount of water conserved
- Energy, water, and labor saving
- Performance measures for domestic use, irrigation standards, and in-stream flows
- Measure input and output of system for quality and quantity
- Consider surveys of groundwater inventory and upstream aquifer recharge rates
- Conventional water quality testing and in-stream flow records